RAILROAD GAZETTE

FRIDAY, DECEMBER 13, 1901.

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Contributions

The Thirty-third Street Station of the Long Island.

TO THE EDITOR OF THE RAILROAD GAZETTE.

In your picture, on page 835, of the proposed Manhattan Terminal of the Long Island Railroad in Thirty-third street, would it not be a good plan to show the outgoing train to the extreme right of the tunnel and raise its track to the level of the bridge shown? This would be inconvenient as putting the platform on the left hand side of the train, but it would save descending the stairs. The same arrangement might be made at the Forty-second street connections between the New York Central and the Rapid Transit tracks. E. M. F.

That Whistling Rule.

New York Central & Hudson River Railroad Co.,
Rome, Watertown & Ogdensburg Division,
Watertown, N. Y., Dec. 9, 1901.

TO THE EDITOR OF THE RAILROAD GAZETTE.

I note your criticism of a "whistling" rule promulgated by the Superintendent of the Rome, Watertown & Ogdensburg, and had it been truthful I would have no word to say; but I assume you do not intend to err and were led into a misquotation by copying some country newspaper article. We have "whistle" rules (standard), as do other lines, and we have had up the subject of reduction of quantity within cities and villages which probably led up to this article, but there is absolutely nothing therein as you published or to be construed as such. Therefore your criticism, I am sure you will agree, was unwarranted as applying to this line.

D. C. MOON, *Superintendent.*

[It is not often that we are trapped into using an unconfirmed report, taken from a daily newspaper, as the basis for editorial comment, having learned by considerable sad experience the folly of so doing. Occasionally, however, our vigilance is relaxed, usually to our sorrow. —EDITOR.]

The Cause of Trains Parting.

St. Louis, Mo., Nov. 20, 1901.

TO THE EDITOR OF THE RAILROAD GAZETTE.

In your issue of the 15th inst. there is given a tabulated statement of the record of trains parting on the N., C. & St. L. R. R., for the year ending July 1, 1901, 817 in number.

If you recur to a paper on the "Car Coupler Problem," which I read before the St. Louis Railway Club, Sept. 13 last, and which was published in the *Railroad Gazette*, on Sept. 27, you will note that I gave the statistics of one month's record from this same road, which was 63 in number. From this record I made the deduction that there were about 120,000 cases of trains parting per annum, on all the roads of the United States. Whether or not my calculations were correct in the aforesaid paper, I will not say here, but take up the more recent year's record of the above road, and see what conclusion is inevitably reached.

This system has 1,200 miles of line and 4,500 freight cars. It also has the reputation of keeping up its rolling stock to the highest standard through a system of the most constant and careful inspection. To this fact there may be added that it has the best roadbed, having the most uniform grade and least number of curves. It also constitutes about $^7/_{10}$ of 1 per cent. of the entire mileage of railroads in the United States.

Now, in the face of all these favorable conditions, in which the coupler now in general use is subjected to the least measure of punishment possible, there is a record of 817 cases of trains parting, upon a system whose mileage consists of $^7/_{10}$ of 1 per cent. of the entire mileage of the United States, is not the conclusion fully warranted that the above record of break-in-twos is only about $^7/_{10}$ of 1 per cent. of the total number, yearly, of such occurrences? In other words, is not the conclusion inevitable that the least number of break-in-twos which the railroads can expect, under present conditions, 116,000 per annum?

In the tabulated statement referred to there are several causes embraced in the "sum total" of the above record, but if a proper analysis of the case is made, it cannot be otherwise than manifest that the disastrous record given has its basis in one original cause, and that is a *rigid coupler;* for it is a rigid coupler that imposes a lateral strain upon the upper and lower lugs, which they are not strong enough to stand and consequently one or both are broken; it is a rigid coupler that causes the coupler to impinge against the draft timbers on either side with such force as to cause the shank to break in two or wreck the draft timbers; it is a rigid coupler that imposes upon the knuckle such a terrible strain, in rounding a curve, that they are either pried open or broken; or the lock that engages the shank of the knuckle gives way; it is also a rigid coupler that causes the rivets, by which the yoke is fastened to the shank of the coupler, to shave off, because they cannot stand the lateral pressure.

Now, if a rigid coupler is the sole cause of this entire train of disasters, it follows as a natural sequence that a flexible coupler is the only remedy. If the railroads of the country were to decide by a concert of action, to equip all cars over 35 ft. in length with a flexible drawhead, and appoint a committee to investigate the merits of all couplers constructed on this principle, the trouble would be largely ameliorated. It is a well-known fact that a flexible drawhead coupled to a rigid drawhead has the same effect as two flexible drawheads coupled together; besides this, such a step would confine the rigid couplers now in existence to the shorter cars of uniform length, the benefit of which is too apparent to require further exposition by any logical syllogism.

When will the railroads wake up to a realization of the gravity of the issue before them, and take the proper steps to eliminate so widespread an evil?

J. B. THOMAS.

A Bonus System of Rewarding Labor.*

BY H. L. GANTT.

The system described in this paper has recently been introduced by the writer into the large machine shop of the Bethlehem Steel Company, and has met with such unqualified success that a description of it would seem to be of interest to the Society. It has caused a complete change in the whole atmosphere of a shop, notwithstanding the fact that it has been in operation for a few months only.

A card is made out, showing in detail the best method (so far as our present knowledge goes on the subject) of performing each of the elementary operations on any piece of work, specifying the tools to be used, and setting the time needed for each of these operations as determined by experiments. The sum of these times is the total time needed to complete the piece of work. If the man follows his instructions, and accomplishes all the work laid out for him, as constituting his proper task for the day, he is paid a definite bonus in addition to the day rate which he always gets. If, however, at the end of the day, he has failed to accomplish all of the work laid out, he does not get his bonus, but simply his day rate. As the time for each detail operation is stated on the instruction card, the workman can see continually whether he is earning his bonus or not, and if he finds any operation which cannot be done in the time set, he must at once report it to his foreman. If, on careful investigation by the man making out the card, the workman's statement is found to be correct—that a portion of the task cannot be done in the time stated on the card—a new instruction card is made out, explaining the proper method of working, and allowing the proper time. It is of the greatest possible importance for the moral effect upon the men that errors in making out instruction cards should be as few as possible. A man must be allowed time only for what is stated on his card, and while a reasonable time must be allowed for each operation, he should fail to receive his bonus if time is lost from any cause whatever. (The foremen also receive, in addition to their day wages, compensation proportional to the number of their men who earn a bonus, and an extra compensation if all of their men earn their bonuses.)

As these cards are made out by a skilful man, with the records at hand, they invariably prescribe a better method for doing the work than the ordinary workman or foreman could devise on the spur of the moment. As all the appliances and instructions necessary for doing the work are furnished, and a fixed premium or bonus is allowed the workman in addition to his regular rate if the work is done satisfactorily in the time set, it will be seen at once that this method is really a system of education, with prizes for those who learn, and the results already obtained bear out this idea of education most fully, for under it men have learned more in a few months than they ever did before in years.

A careful consideration of this system will show that, while it is not a system of piece work, it has many of the advantages of differential piece work, by which I mean that the compensation is *quite large for the maximum amount of work obtainable, and quite small for anything less than this amount.* For instance, if a man does all that is asked of him, which must always be possible, he gets a large extra reward; but he gets no reward, except his ordinary day rate, if he falls short of this amount. The extra bonus which the bosses earn when all of their men perform the maximum amount of work is a strong inducement to make them teach their inferior men.

Again, as it is impossible for the men to earn their bonuses when their machines are out of order, it furnishes an automatic punishment for breakdowns, for the man not only loses his bonus on the day the machine breaks down, but on all subsequent days until the machine is running satisfactorily again.

This system possesses an advantage over direct piece work in that it is more flexible and can be introduced with greater ease and under conditions where piece work proper would be impossible. When it is realized that proper piece work will, in many cases, produce at least three or four times as large an output as ordinary day work, the difficulties of putting directly on piece work men who have been accustomed to doing work in their own way and in their own time would seem to be, and generally is, extremely difficult. If the instruction card is made out and a substantial bonus offered, time will do the rest.

When a piece rate is made out for any kind of work with which the men are not thoroughly familiar, it is obviously only simple justice to them that they should have detailed instructions as to the way to accomplish each of the elements of the work in the time needed to earn fair wages. If we allow the men their day rate and offer them a bonus or premium for doing the work in accordance with our instruction cards, they see at once that they have nothing to lose by conforming to our wishes, and all to gain, with the result that they will in a short time make an effort to do the work in the manner and time set. As we stated in advance, these instruction cards do not necessarily represent the best possible method of doing the work, but the best method which we could devise at the time, and we have found that there is practically no objection on the part of the men to a change of time on these cards, so long as the new time corresponds to a new set of instructions which will enable them to perform the work in the time set. It is hard to over-estimate the value of a complete set of instructions showing the best method of performing a piece of work.

In order to make proper instruction cards for a machine shop doing a variety of work, it is necessary to know the laws of the cutting of metals, as well as the time for handling work in this particular shop. The laws referred to are very complicated, but here again Mr. Taylor has made such a start as to render it possible to determine the best method and time for rough-machining steel. The results of his experiments on lathes were reduced to a slide rule by the writer for convenient use. This slide rule has been improved by Mr. Carl G. Barth, who has also extended it to planers, drill presses, and slotters, and who made out slide rules for a number of machines in the large machine shop of the Bethlehem Steel Company. By means of these slide rules we can determine promptly the most economical feed and speed with which to perform any operation on a piece of steel when the physical qualities of the steel are given.

As an illustration of exactly how instruction cards are made out in a machine shop, we may cite the case of a forging that has to be rough-machined. The drawing first goes to an expert mechanic, who has charge of what is known as the routing of the piece through the shop. He decides the order in which the various operations of turning, planing, slotting, drilling, etc., are to be done. In a shop doing a variety of work, too much stress cannot be laid on the routing, for, besides the advantage of knowing in the office the progress of the work, the saving made by performing the various operations in the best order is very great. This subject of routing is large enough to take up a paper by itself, so it can only be mentioned here. If the first operation to be performed is that of turning, the forging is assigned to the lathe best fitted for handling this particular job. The work to be done on the machine is then analyzed by a first-class machinist, who has been instructed in the use of the slide rule, and who makes out an instruction card on which the operations to be performed on this lathe are placed in the proper order,

*Extracts from a paper presented at the New York meeting (December, 1901) of the American Society of Mechanical Engineers.

with proper instructions, the calculated time being given for performing each operation. The kind of tool to be used, the feed, and speed are specified for every machine operation. For every other operation, such as putting in and taking out work, laying out, changing feed gears, etc., instructions are given, and the time that each should take is placed directly opposite the description, in a column designed for that purpose.

Inasmuch as no bonus whatever is paid unless the men actually perform the work called for on their instruction cards in the time set, it is to the interest of the men to prevent accidents to the machines, and to avoid unnecessary delays, whether such delays are their own fault or the fault of other people. Among the results we have obtained are:

First. A very large increase in output, averaging from 200 to 300 per cent.

Second. A falling off in accidents and breakdowns.

Third. A quickening of the intelligence of the men. For instance, men who could formerly do nothing for themselves, but were obliged to ask the foreman all kinds of questions, now find that they can do the work by asking fewer questions, for if they spend a large proportion of their time hunting the foreman they lose their bonus. One man, for instance, who in three years had never learned to change the feed gears of his machine properly without the assistance of his foreman, lost his bonus three days in succession because they had not been properly set. He at once learned to set them, and has had no difficulty from this cause since.

In making a comparison between the bonus system and proper piece work, it will be recognized at once that each has its advantages. If we have a thorough knowledge of all the conditions, and are able to introduce piece work, it is undoubtedly to be preferred; but we must remember that, aside from the injustice, there is nothing so demoralizing as cutting piece rates, and it is not only extremely difficult to make out proper piece rates, but it is still harder to convince men who have been accustomed to working by the day only, that it is possible for them to earn fair wages when proper rates are set. On the other hand, as the bonus is paid to men in addition to their day rate for performing the work in the manner and time called for by their instruction cards, they do not feel hostile toward the innovation.

Although the results are very far in excess of what was anticipated, the writer does not feel that we have yet taken advantage of all our opportunities. As before stated, the system is one of education, with prizes for those who learn; but the prizes have so far been awarded for learning and doing only what our experts already knew. The next and most obvious step is to make it to the interest of the *men to learn more than their cards can teach them*. So far nothing has been done in this line, not because the need for some such provision has not been felt, but for the reason that no entirely satisfactory method has suggested itself.

DISCUSSION.

Mr. T. H. Halsey criticised the system on the ground that it did not give enough data to make it possible to apply it to the ordinary shop, and it fails to explain how the average rates of shop operation can be made to give the maximum rates to be used under this system. The case of the Bethlehem Works seems to be unique and one which especially lends itself to the introduction of such a system. All of the work done is large, the shapes are simple, the machine work is mostly roughing, and the material is made on the premises so that it is possible to have a full knowledge of all of its characteristics; it is seldom repeated so that estimates must be made, the time required for the performance of the work is long and the equipment for doing it is large. All of these points serve to make the system thoroughly applicable to this particular place. The premium plan seems to be better in that it is exceedingly simple and flexible. The success that has attended the introduction of the bonus system at Bethlehem is probably due to the peculiarities of the circumstances and it cannot be applied to the ordinary machine shop.

A criticism was offered on the ground that the paper apparently ignored the value of the details that are necessary for the proper formulation of the instruction papers, and as to how this detailed information was obtained. It is apparently essential to know the machine, the tool steel and the material in all of their minor characteristics and it would be interesting to know how this is to be obtained in the case of a general machine shop.

It should also be considered that there are two kinds of shops in which it may be desirable to introduce these methods of payment, those in which work is duplicated, and those in which it is not. The Westinghouse Air Brake Co. and the Westinghouse Machine Co. may be taken as examples. In the former it is safe to say the most approved methods of production are used for every part, while in the latter, where duplication is not a necessary feature, it is not probable that every piece of work is done in the manner in which it would be were it to be indefinitely duplicated.

Again, one of the very serious difficulties in getting the maximum results is to be found in the faulty design of the machine tools themselves.

The most elaborate discussion was by Mr. Fred W. Taylor in support of the system. Some years ago he presented a paper on the differential system of compensation which attracted a good deal of attention and which he was rather disposed to consider a mistake in that it had not been sufficiently developed. He considered what he called the elementary rate fixing as the most important point in the whole work, and it should be the first to receive attention. As an example of the thoroughness with which this work has been done at the Bethlehem Works, he cited that accomplished in connection with shoveling dirt. This would seem to be an apparently simple proposition, and yet they have had two college graduates with several assistants busy for three years gathering data on the subject. When the proposition was first made to attack the subject with such a corps it was ridiculed as absurd and the methods suggested seemed almost idiotic. These men were furnished with especially made stop watches that registered hundredths of a minute instead of seconds to facilitate the calculations. They were also furnished with suitable blanks for keeping the records.

Now the shoveling of dirt may seem to be a very simple matter, but it should be resolved into at least two and preferably three distinct elements. The reason is that the time varies with different materials and conditions. That is to say, the time required to thrust the shovel into the mass is different when it is put in at the top from that at the bottom when there is a smooth board floor to work upon. It varies with material and takes longer in the case of coke, for example, than in fine sand. It varies more in the going in than it does in the drawing out, while the throwing depends upon the height and distance at which the material is to be placed. The material itself makes no difference in the time required to throw it.

The weight removed at each shovelful depends on the man. A powerful laborer will take 22 lbs. at each shovelful, while the average man will not take more than from 12 to 14 lbs. After an immense amount of information of this sort had been gathered it was found to be necessary to do it all over again and use shovels that were adapted to the work. That is, new sets of shovels were procured and instead of sending a man out in the morning with a shovel and allowing him to carry it all over the premises using it on coke and ore indiscriminately, shovels of different sizes and shapes were used for the different materials.

The result of this elaborate investigation is that, while, before the establishment of this system, there were between 400 and 500 laborers employed on the premises at $1.15 a day, the work is now done by 85 men who are paid at the rate of $1.85 a day.

The same thing is shown with the handling of pig iron. Before the introduction of the system, one man would load about 12 tons of pig iron a day and the cost was about 9½ cents a ton. Under the new rate a man loads 45 tons and the cost is a trifle more than 4 cents. It is not every man who is physically capable of standing this pace of loading 45 tons of pig iron a day, and the lighter and weaker men fell out and went to other work; but, as soon as it became known that the laborers were able to earn $1.85 a day handling pig iron, they began to come in from all parts of the country and a selection could be made, and now there are a picked lot of men engaged on this work. They are happy and contented and out of the whole lot of laborers on the grounds only two are drinking men. In fact a man cannot be a drinking man and hold that pace. They are nearly all savers, with money in the bank.

In establishing such a system the place to start is with the foremen. As a general rule the duties of a foreman are vague, and the good foreman is almost impossible to procure. It requires a peculiar combination of properties that are rarely embodied in one man and then somebody else wants him badly. The solution of the difficulty lies in divided foremanship. Any man can be taught one of the elements of foremanship in a short time, but it takes years to train a man for good all-round work in this line. At Bethlehem the work was divided into six different elements, an arrangement that is only possible in large shops. These divisions are as follows:

1. The speed boss, whose duties are to see that the machines are run at the proper speed; that the depth of cut and the feed are correct; that the proper tools are used for the work and that they are properly set.

2. The gang boss, upon whom devolves the responsibility of the preparation of the work. He must see to it that there is always one day's work ahead; that the next piece to be finished is at hand with the carrier clamped in position; that all gages, rests, drawings and other appliances that will be needed at the machine for the performance of the work are at hand. This is all that he has to do and he soon becomes skilled at it.

3. The inspector, who is responsible for the quality of the work.

4. Foreman for the compilation of time reports and cost reports.

5. The care of the machinery, to see that it is properly oiled and kept in good condition; that the belts are in proper shape, etc.

6. Compilation of instruction cards. This is done in the office from the drawings and specifications by expert machinists.

7. Disciplinarian who comes in to settle disputes between foremen and workmen and upon whom devolves the responsibility for the order and discipline of the shop.

Such a system of divided foremanship was not recommended as a permanent thing, but merely as an expedient to bridge over the interval of the introduction of piece work, because a good foreman capable of taking charge of the work in its entirety is impossible to get. One of the early troubles with this divided foremanship was that the men are continually attempting to do each other's work. The gang boss tries to regulate the speed and the speed boss thinks he ought to inspect and so on through the whole corps. This is, however, soon remedied and, when the men begin to attend to their own business, and let that of the other man alone, everything runs smoothly.

In introducing the system it has usually been found to be necessary to bribe the first man by offering him a good round sum to accomplish the desired result. After it has been once started, however, it has been found that a bonus of 75 cents a day to machinists and 50 cents to helpers is quite sufficient.

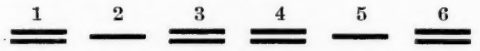
The rate-fixing department is quite as important as the drawing room. Fifty years ago few engineering establishments had a drawing room, but it is now considered to be absolutely essential to the proper conduct of a manufacturing establishment, and it is safe to say that 30 years hence a rate-fixing department will be considered fully as essential to success as a drawing room. The objection that is usually made to this department is that it is an extra expense for which there is no return. But it must be remembered that the work which it does must be done somewhere. It is usually done in the shop on the spur of the moment by the man at the lathe or the foreman, who does not give it the proper consideration as to how the work is to be done. It stands to reason, then, that a man who devotes his whole time to the subject is better fitted to carry it on than a man who has it thrust upon him and must decide off-hand as to how he will do it. When a pump is to be built the men in the shop are not told to build a pump as it may please them, but the work is first designed and drawings are furnished. The same common sense principle will apply to rate fixing and its attendant work of specifying the method of doing the work.

The instruction cards are a most important element in the work, and too high a value cannot be placed upon them. They were first used for cleaning of boilers, and by their means the cost was cut down from $60 to $11, while the men employed were actual gainers in the wages received. They were next used for cleaning drains, overhauling machines and similar work. They are especially valuable in carrying out process work where tentative experiments are to be made in the hope of effecting improvements, as they furnish a record of the methods previously followed that are invaluable for reference. This was notably the case in the cooking of sulphide pulp, where by the judicious use of a series of instruction cards the time of cooking was reduced from 72 to 40 hours.

The Electric Equipment of the Manhattan Elevated.

In the *Railroad Gazette*, Nov. 30, 1900, and May 17, 1901, we gave a general description of the new Manhattan Elevated power house and its equipment, the third-rail track work, the new motor cars and their control, results of experimental acceleration tests on the Second Avenue Line, and also the order in which trains will be made up and run when electric power is used.

The apportionment of motors will be two motors to each of four cars in every six-car train, the make-up of the train being as follows: Car No. 1, head end, motors; car No. 2, a trailer; cars Nos. 3 and 4, motors; car No. 5, a trailer; and car No. 6, a motor car. This train make-up is shown in the diagram:



Trains of five cars will no longer be used in the service and it is therefore apparent that, when in the rush or slack hours of the traffic it is necessary to increase or reduce the number of cars the yard work will be extremely simple. The first reduction from a six-car train will consist of cutting off a motor car and one trailer from one end of the train, thus reducing the regular day service to trains of four cars, three of which will be motor cars, When it becomes necessary to use the three-car train service the motor car which we have referred to in the order of location as No. 3 or No. 4 (as the train may head) will be detached and run into the yard. There will be no further occasion for reduction of the number of cars until the hours of the midnight service are reached, when the first switching operation at the yard will be necessary and the trailer referred to as Car No. 5, or No. 2, will be switched out and the midnight service will consist of trains of two motor cars.

One big engine and generator and the boilers are practically complete and the second engine and generator are in the power house and well along toward complete installation. The first shipment of the 300 new cars ordered from the Wason Mfg. Co., Springfield, Mass., and the American Car & Foundry Co., Wilmington, Del., will be received in New York next week and shipments will continue steadily until all of the cars are received. The third-rail work on the Second and Third Avenue lines is done, and on the Sixth and Ninth Avenue lines it is well under way.

It is evident that it can be but a short time until the plant is ready to generate current and that trains run by electric power may be expected now at any time. The Second Avenue line will receive current and go into regular electrical operation first. We shall presently supplement all that we have previously published, by giving illustrations showing the arrangement of the power house and some of the other equipment, and probably give some information about the power house and equipment in detail.

Brooks Chautauqua Type Passenger Locomotives—Buffalo, Rochester & Pittsburgh.

The accompanying half-tone illustration is from a photograph of a Chautauqua type passenger locomotive built at the Brooks works of the American Locomotive Co., for the Buffalo, Rochester & Pittsburgh Railway. Two of these locomotives were delivered in August. The line drawings show the latest improvements of the radial trailing truck, patents on which were granted to Mr. John Player, Mechanical Engineer, of the Brooks Works, May 7, 1901.

In our issue of Nov. 30, 1900, a Burlington, Cedar Rapids & Northern locomotive of this type was described. The total weight of that locomotive is 158,600 lbs., cylinders 19½ x 26 in., valves 10-in. piston, total heating surface 2,551.8 sq. ft., grate area 40.7 sq. ft., and working steam pressure 210 lbs. per sq. in.

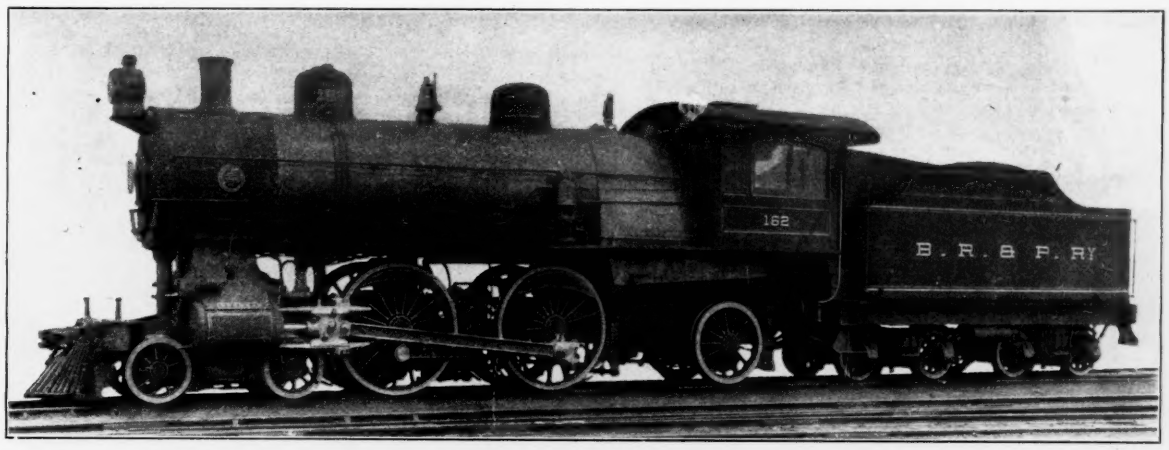
One of the Chicago, Rock Island & Pacific Chautauqua type locomotives was illustrated and described in the *Railroad Gazette*, April 26, 1901. That locomotive weighs in total 167,500 lbs., the cylinders are 20¼ x 26 in., the valves 11-in. piston, total heating surface 2,806 sq. ft., grate area 55.7 sq. ft., and working steam pressure 210 lbs. per sq. in. We are informed that these locomotives are doing very good work, sometimes hauling passenger trains of 14 cars on a quick schedule, with no difficulty in feeding the boiler sufficiently with one No. 9 injector. They have made a record for being "smart" and economical.

From the general description of the Buffalo, Rochester & Pittsburgh locomotive, given herewith, it may be noted that the total weight is 173,000 lbs., cylinders 20¼ x 26 in., valves 11-in. piston, total heating surface 3,007.9 sq. ft., grate area 54.43 sq. ft., and working steam pressure 220 lbs. per sq. in. While there has been no increase of cylinder dimensions in the B., R. & P. locomotive, as compared with the C., R. I. & P. locomotive, yet the greater weight, and heating surface and higher steam pressure represent increased power, and the three locomotives here considered show a nice progression in heavy motive power for passenger train work.

The general description of the B., R. & P. locomotive follows:

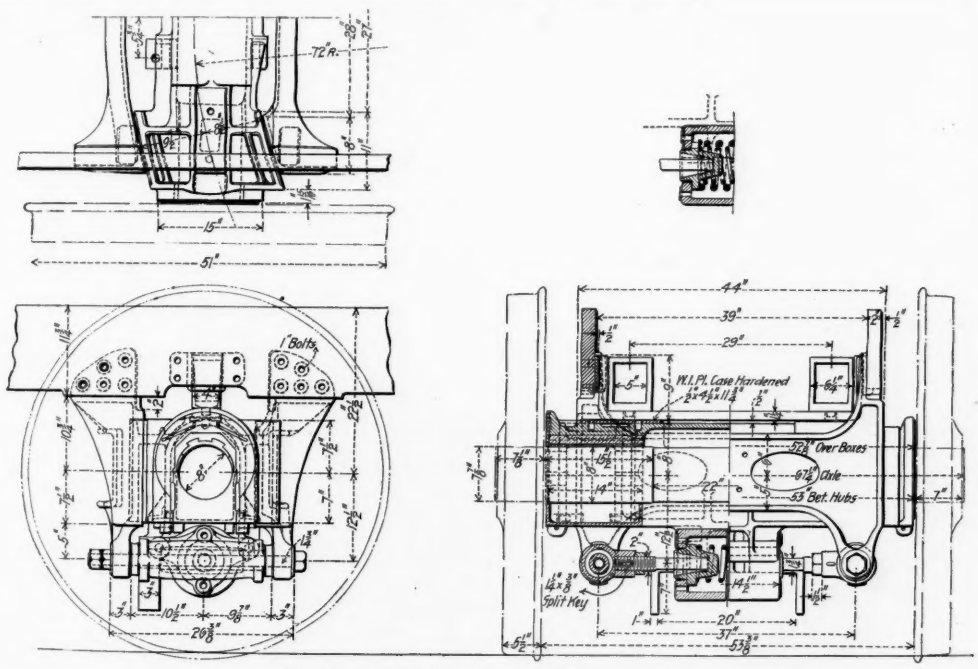
General Description.

Fuel	Bituminous coal
Weight on leading wheels	40,000 lbs.
Weight on driving wheels	99,000 lbs.
Weight on trailing wheels	34,000 lbs.
Weight, total	173,000 lbs.
Weight tender, loaded	120,000 lbs.
General Dimensions:	
Wheel base, total of engine	29 ft. 2 in.
Wheel base, driving	8 ft. 0 in.
Height center of boiler above rail	9 ft. 7½ in.
Heating surface, fire-box	202.3 sq. ft.
Heating surface, tubes	2,805.6 sq. ft.
Steam ports, width	17/8 in.
Exhaust ports, least area	68 sq. in.
Bridge, width	3 in.
Valves:	
Valves, kind of	11 in. diam., improved piston
Valves, greatest travel	5⅜ in.
Valves, steam lap (inside)	1⅛ in.
Valves, exhaust clearance (outside)	0 in.
Lead in full gear	3/32 in.
Boiler:	
Boiler, type	Straight top
Boiler, working pressure	220 lbs. per sq. in.
Boiler, material in barrel	Steel
Boiler, thickness of material in shell	¾ in., 9/16 in., ½ in.
Boiler, thickness in tube sheet	¾ in.
Boiler, dia. of barrel front	70⅛ in.
Boiler, dia. of barrel at throat	71⅝ in.
Seams, horizontal	Sextuple
Seams, circumferential	Triple
Crown sheet stayed with	Radial stays
Dome, dia. inside	30 in.
Fire-box:	
Fire-box, type	Wide



Brooks Chautauqua Type Passenger Locomotive—Buffalo, Rochester & Pittsburgh Railway.

Fire-box, length	108 in.
Fire-box, width	74 in.
Fire-box, depth, front	74 in.
Fire-box, depth, back	64 in.
Fire-box, material	Steel
Fire-box, thickness of sheets	Crown, ⅜ in.; tube, ⅝ in.; side, ⅝ in.; back, ⅜ in.
Fire-box, brick arch	On water tubes
Fire-box, mud ring width	3½ in. back, 3½ in. sides, 4 in. front
Fire-box, water space at top	7 in. back, 6 in. sides, 4 in. front
Grates	Rocking
Tubes, number of	336
Tubes, material	Charcoal iron
Tubes, outside diam.	2 in.
Tubes, thickness	12 B. W. G.
Tubes, length over tube sheets	16 ft. ¼ in.
Smoke-box:	
Smoke-box, dia. outside	73 in.
Smoke-box, length from tube sheet	65 in.
Other parts:	
Exhaust nozzle	Single, permanent
Exhaust nozzle, dia.	5⅛ in., 5 5/16 in., 5½ in.
Exhaust nozzle, distance of tip below center of boiler	6 in.
Netting	Wire
Netting, size of mesh	2½ x 2½ No. 12 wire
Stack	Taper
Stack, least diameter taper	15 in.
Stack, greatest dia. taper	16⅞ in.



The Improved Player Radial Trailing Truck.

Heating surface, total	3,007.9 sq. ft.
Grate area	54.43 sq. ft.
Wheels and Journals:	
Wheels, leading, dia.	33¼ in.
Wheels, driving, dia.	72 in.
Wheels, trailing, dia.	51 in.
Material of wheel centers	All cast steel
Type of leading wheels	Standard
Type of trailing wheels	Improved Radial Axle
Journal, leading axles	5½ x 12 in.
" Leading axles, wheel fit	5½ in.
Journal, driving axles	9½ x 12 in.
" Driving axles, wheel fit	9¾ in.
Journal, trailing axles	8 x 14 in.
" Trailing axles, wheel fit	7⅞ in.
Cylinders:	
Cylinder dia.	20¼ in.
Cylinder stroke	26 in.
Piston rod, dia.	3¾ in.
Main rod, length center to center	139 in.
Steam ports, length	25½ in.
Stack, height above smoke-box	27 in.
Tender:	
Tank, capacity for water	6,000 gals.
Tank, capacity for coal	10 tons
Type of under-frame	Steel channel
Type of trucks	B. W. all metal trucks
Type of springs	Triple elliptic
Dia. of wheels	33½ in.
Type of draw-gear	B. W. twin spring
Special Equipment:	
Brakes	American for driver; Westinghouse for tender and train service.
Pump	9½ in.
Sight feed lubricators	Michigan
Safety valves	Kunkle
Injectors	Hancock composite
Steam heat	Consolidated improved
Springs	French
Metallic packing, piston rods	United States
Metallic packing, valve stems	Brooks Works

Improvements in Car Couplers.*

However perfect the automatic coupler may be in general design, however near perfection it may appear, the record of railroad operations brings to light many instances of failure to satisfactorily perform all the functions for which it is intended. One of the most serious is the "break-in-two," or train parting, which in many cases results in disastrous wrecks. I was much interested in an article, "The Car Coupler Problem," by Mr. J. B. Thomas, of the St. Louis Railway Club, published in the *Railroad Gazette*, Sept. 27, 1901, page 663. Mr. Thomas says, in speaking of "breaks-in-two":

a. "We have the startling record of 10,000 breaks-in-two every month, or 120,000 every year. The loss from wrecks occasioned by the accidents must run up into the millions every year, or enough to equip one-half the cars of the country with a coupler that will make 'breaks-in-two' largely a thing of the past.

b. "It is a well known fact that 95 per cent. of the knuckles are now retired after a six or 12-months' service because the inner face is worn to the danger point, while the body of the knuckle is comparatively intact." The estimates given by Mr. Thomas correspond to one "break-in-two" for about every 55 freight trains. This seems to be large, and probably about one in 100 trains would be nearer the average for the United States.

His estimate that 95 per cent. of the knuckles are worn out in six to 12 months may also be a little high. There are, however, lines of railroad with considerable curvature where knuckles in passenger service are retired after six weeks and two months in service. On switching engines they have to be renewed generally after three months' service. In freight service many failures occur within 12 months. Observation shows that about—

60 per cent. of the knuckles fail through wear of the contact surfaces.

30 per cent. fail owing to breakages of the tongue and hub.

10 per cent. fail owing to other causes, flattening, etc.

Based upon these observations and the general experience of transportation officials the demand for knuckles giving longer periods of service is apparent. On the ordinary knuckle the rapid wear soon makes the contact surfaces flat, thereby throwing the line of pull, or thrust, to the outer edge, making a transverse strain two or three times greater than when the knuckle is new. This causes breakages in the hub and tongue, and is, also, the source of "breaks-in-two."

Many knuckles are made of a poor quality of steel; many are soft steel, or wrought iron, or malleable iron, causing thousands of failures from wear within periods of six weeks or two months. A knuckle is needed whose contact surface is durable, and will preserve the line of thrust, as intended in the original design of the automatic coupler.

According to the estimate of Mr. Thomas that 95 per cent. of the knuckles are to be replaced every year, there will be required annually for renewals on the 1,423,318 locomotives and cars 2,704,000 knuckles. The cost of such replacement would be about $3,000,000 annually. Can some of this expenditure be saved? Assuredly, yes?

To a large degree, it can be done only by making the contact surface of the knuckle from a superior grade of hard steel, a suggestion in line with the plan adopted in the construction of the anvil faced frog. One of our large manufacturers of knuckles observed that the firm with which he was connected was manufacturing about 125,000 knuckles per year; that many were returned on account of wear as scrap. He conceived the simple plan of facing the contact surface with a piece of self or air-hardening steel about ¼ in. in thickness. It was cast in the knuckle; trials were made in the severest kind of service; on engines, switching, freight and passenger, and on passenger and freight cars, and the results were far beyond the most sanguine expectation. A year's service, with a 100,000 miles' run, failed to show any appreciable wear in this improved knuckle, and it is believed it will be good for 200,000 mileage. Ordinary

*Extract from a paper read by J. I. Ferguson before the Indianapolis Railway Club, Oct. 9, 1901.

knuckles in the same surface were worn out inside of six weeks. The relative merits of the ordinary knuckle and the knuckle provided with the hard steel contact face shows that where replacements are made every two months, with cost of replacement knuckles at $1 each, counting interest at 6 per cent. in two years the ordinary knuckle will cost $14.53, compared with the improved knuckle at a cost of $3.53, or four times as much.

To an additional saving in the number of knuckles broken and worn out, the adoption of some automatic device for making couplings on sharp curves would contribute materially. Probably 30 per cent. of all the switching engines, particularly in large cities and industrial centers, are obliged to use sharp curves in shifting cars in yard tracks and industry sidings, which require shackle bar or link and pin couplings. The sharp curve coupler should be automatic, and eliminate the necessity of going between engine and car when making a coupling. It should be a device that will permit of dispensing with the pin hole and slot in the knuckle. It should be readily applied to the ordinary coupler of the engine, should be light and durable and capable of being used in both pulling and pushing cars.

The automatic feature removes the necessity of trainmen going between cars to couple or uncouple on sharp curves, and thereby makes liability to personal injury very remote. Such a device, if successful or practical in operation, will admit of better construction of the knuckle, i.e., by doing away with the slot insure more wearing surface and greater strength. The 1⅝ in. pin hole would not be necessary. A hole about 1 or 1⅛ in. in diam. should be left in the knuckle to insure a more uniform strength in the casting. Such a change in reduction in the diameter of the pin hole will allow greater thickness of metal, and prevent flattening. One company whose cars are not allowed to go over foreign lines has all of its coupler knuckles made without pine hole or slot.

The manufacturer before mentioned as having conceived the insertion of self hardening steel on the contact surface, was fully alive to the necessity for the sharp curve automatic coupler. His study of the problem resulted in his formulating a plan for an automatic coupling device to be used on sharp curves, with a view particularly to eliminating the slot and pin holes. It is simple, light, durable and made of cast-steel. It is called the sharp curve coupler. It is simply a link, or clevis, placed over the knuckle of the coupler on the engine. This clevis is connected with a pivotal jaw of the shape of the ordinary jaw of a coupler, but with such contour lines that the jaw when coming in contact with the knuckle on the car locks with it and forms a complete coupling. Tests made on curves to the right and to the left, with radii as low as 75 ft., or 75 deg. curvature, showed it to be perfect. It is estimated that the general use of this device will do away with at least half of the failures of knuckles under the last two causes before observed.

Train Resistance

At the ordinary meeting of the Institution of Civil Engineers, on Tuesday, Nov. 26, the paper read was "Train Resistance," by J. A. F. Aspinall, M. Inst. C. E., General Manager of the Lancashire & Yorkshire.

This paper dealt with the results of experiments carried out with a dynamometer car on the Lancashire & Yorkshire Railway, in an endeavor to arrive at the tractive effort required to haul modern carriages.

The author stated that a long series of experiments, the results of which were not recorded in the paper, had been previously tried, but that the effects of the wind upon trains were such as to require a much closer investigation into this special branch of the subject; and the records presented in the paper were the results of a careful set of experiments made with a view to show how much more important the question of wind pressure was, as affecting trains, than any other item of which the total resistance was made up. The several instruments used for determining the velocity and direction of the wind were described, and it was mentioned that the apparatus fixed in the car allowed two separate diagrams to be taken. One diagram recorded: (1) Tractive effort; (2) thrusting effort; (3) speed in miles per hour; (4) velocity of the wind; (5) time of application of brake; (6) time occupied in minutes; (7) distance traveled; and (8) points at which indicator diagrams were taken.

The second diagram was arranged to show (1) tractive effort; (2) thrusting effort; (3) speed in miles per hour; (4) revolutions of car wheel; and (5) time occupied on journey.

The method of coupling engine and dynamometer car by a rigid coupling was described, and details were given of the tests of the draw-bar springs. Modern bogie carriages fitted with oil axle-boxes had been used for the experiments, the number of carriages being varied, and the results being recorded in each case. Diagrams showing the wheel bases, illustrations of the axle-boxes and journals, and a statement of the weights of the vehicles, were given in the paper, so as to show clearly the nature of the stock experimented with.

Tests had been made at speeds varying between five and 50 miles an hour on the railroad between Wigan and Southport, this line having been chosen as it was almost straight and had easy gradients. The trials had been conducted in the following manner: The position of the regulator and reversing gear on the engine was marked for each trial, these positions being governed by the speed at which it was desired to run. After the regulator and wheel had been set they were left in position during the whole of the run, the engine being allowed to acquire whatever speed it could, and steam pressure being kept as constant as possible. Both the outward and return journeys were made with the engine set in exactly the same position. This was judged to be the best method of ascertaining the tractive force required to haul the train at different speeds, as the acceleration which would have been caused by altering the position of the regulator was entirely eliminated; and the gradients being very slight, it was possible to obtain readings at a constant speed for a mile or more.

The author drew attention to apparent discrepancies in the results of several experiments, and suggested the probable causes thereof. The mean result of these tests, however, was embodied in the formula

$$R = 2{\cdot}5 + \frac{V^{\frac{5}{3}}}{50\,8 + 0{\cdot}0278\,L}$$

where R was the resistance in pounds per ton, V the velocity of the train in miles per hour, and L the length of the train, over coach bodies, in feet. Numerous "coasting" experiments with trains of different lengths, with and without engine, had also been made, and the results were recorded in diagrams. On other portions of the railroad, where the gradients admitted of it, experiments had been made to see on what incline a train would start by itself; and the results had led to the conclusion that the starting resistance was about 17 lbs. per ton. The author had attempted to resolve the total resistance indicated by his formula into its components, viz., axle friction, atmospheric resistance, and miscellaneous resistances, the latter including resistance due to oscillation and concussion, flange friction and rolling friction. Having explained the method of calculating the axle friction, he next dealt with the atmospheric resistance, comparing the results obtained with those of experiments made by Smeaton, Nipher and Goss.

Indicator diagrams had been taken from the engine drawing the dynamometer car and train, but the results had not shown any well-defined relation between the indicated horse-power and that calculated from the tractive effort, as recorded simultaneously by the dynamometer, and the speed of the train.

In conclusion, the author pointed out that the formulas given were applicable only to the particular trains tried, under the circumstances described. The ever varying nature of the conditions of running in practice—with trains sometimes short and sometimes long; fitted with grease or oil axle-boxes; run upon well or badly kept roads; fitted with brake blocks which hung free from the wheels, or were constantly tipping against them; and subject to a number of other influences which might assist or retard their motion—rendered it almost impossible to find a formula which could be applied in every case.

The paper was accompanied by an appendix giving in tabular and in graphic form the results obtained by a number of previous investigators, with references.

The report of the paper as above is from the columns of *The Engineer*, and below we give a few words from the editorial comment of that journal. We are left uncertain as to Mr. Aspinall's exponent of V in his formula. *The Engineer* prints it as $\frac{5}{3}$, also as $\frac{3}{2}$; while *Engineering* omits the exponent entirely and *Transport* uses $\frac{3}{2}$ as a coefficient and not as an exponent at all. We have decided to guess at $\frac{5}{3}$.

"Mr. Aspinall explained that all the diagrams and documents on which the paper was based were in the hands of the Secretary of the Institution, and at the disposal of anyone who questioned Mr. Aspinall's statements, or regarded his deductions with doubt. We fancy that these papers will remain untouched. The diagrams, with which the walls of the hall were covered, bore silent testimony to the enormous amount of labor that was expended in carrying out a series of experiments which are bound to become classical. Yet, elaborate as was the inquiry carried out by Mr. Aspinall and a large staff, it is noteworthy that he felt it incumbent to warn his hearers that they must not generalize too freely.

"One of his diagrams was extremely suggestive. It was closely covered with curves of resistance, calculated from the formulæ for that resistance given by a number of engineers, home and foreign, who had all tried to settle on some definite empirical rule for calculating the power required to haul a train. Not the least valuable feature in Mr. Aspinall's paper was the emphasis which it gave to the influence of apparently very small disturbing forces in augmenting resistance. . . .

"Lardner discovered what has been since re-discovered by many others—namely, that the more heavily a vehicle was loaded the less was its resistance per ton. A light coach train, weighing about 40 tons, had a resistance at 31 miles an hour of about 25 lbs. per ton, while another similar train, weighing 50 tons, running at 44 miles an hour, had a resistance of only 22.4 lbs. per ton. . . . In the words of Dr. Lardner, 'Thus was established the general principle that the resistance of the atmosphere to railroad trains, other things being the same, depends on the volume or magnitude of the coaches.' Mr. Aspinall's experiments confirm the accuracy of most of Dr. Lardner's conclusions. Thus, for example, we find the resistance per ton of a train of unloaded wagons, 1,045 ft. long, to be 18.33 lbs. per ton at 26 miles an hour, while the same train—the wagons being loaded and the speed unaltered—had a resistance of only 6.21 lbs. per ton. If we suppose that the wagons empty weighed 5 tons each, we have a tractive effort per wagon of 96.65 lbs., and if the loaded wagon represented 15 tons, the tractive effort per wagon would be 93.15 lbs. From this it would seem that the work done in hauling a train of empties may be nearly, if not quite, as great as that expended in hauling full trains. The reason for these things is, as far as possible, set forth in Mr. Aspinall's paper, but many things remain which must, for the present at least, be accepted as standing puzzles.

"Mr. Aspinall supplemented his paper with some more recent information. Among other things he gave a table of train resistance. The coaches were of the double four-wheeled bogie corridor type, with oil axle-boxes, and in perfect order. A few of the figures given in this table we reproduce. One of the most important facts ascertained was that the heavier the train the less the resistance per ton—Lardner over again. Thus the resistances for a train 800 ft. long, weighing 322 tons, at speeds of 10, 30, 50, and 70 miles per hour, were 3.1 lbs., 6.5 lbs., 11.8 lbs., and 18.8 lbs.; with a train 285 ft. long, weighing 115 tons, at the same speeds the resistances were 3.3 lbs., 7.4 lbs., 14 lbs. and 22.8 lbs. The extremely small resistances at low speeds come rather as a surprise. If they apply equally to loaded goods trains, it will be seen how economical must be the slow haul of American railways as compared with the fast transport work of our trains. The American train resistance at 10 miles per hour would be just one-half that of ours at 30 miles an hour, and the horse-power of the English engines would need to be just six times that, ton for ton of load, of the American engines. . . .

"During the discussion we fancy that a good deal may be said with advantage about the net horse-power available for pull. It was found that a ten-wheeled Lancashire and Yorkshire engine absorbed 34 per cent. of the indicated power; that is to say, the pull on the draw-bar at the back of the tender represented 66 horse-power out of every 100 indicated. This is a very high result, and speaks volumes for the admirable character of the design and workmanship. A leading French authority found that his engines absorbed 57 per cent. of the power, and Dr. Dudley gives 55.76 per cent. as being absorbed by some locomotives which he tested in the United States."

The Master Car Builders' Draft Gear Tests.

Pursuant to the notice given in the circular of Oct. 31 (*Railroad Gazette*, Nov. 8, page 771) a joint meeting of the Committee on Draft Gear and draft rigging manufacturers was held at the Auditorium Hotel, Chicago, Nov. 20, 1901. The committee met prior to the joint meeting and made certain modifications of the plan as outlined in the circular. The following draft rigging manufacturers were represented: Standard Coupler Company, Westinghouse Air-Brake Company, National Coupler Company, Dayton Malleable Iron Company, Gould Coupler Company, W. H. Miner, Thornburgh Coupler Attachments Company, C. W. Needham, Railroad Supply Company and Dr. X. C. Scott. The plan of tests, as outlined in the circular of Oct. 31, and subsequently modified by the committee, was discussed, and as a result of this discussion the following plan was agreed upon.

Plan of Draft Riggings Tests.

Nature of Tests.—The draft rigging tests will consist of: *First*, Tests under the standard M. C. B. drop testing machine, and *second*, Tests in a 300,000-lb. capacity tensile testing machine. These tests are expected to show the efficiency of the different riggings and their relative standing under shocks and under steady pulls.

Testing Apparatus.—The drop testing machine used will be the one at Altoona, Pa., owned by the Pennsylvania Railroad and built according to M. C. B. standards, and shown in the *Proceedings* of the Association. The limit of this machine is a drop of 40 ft., and the weight used is 1,640 lbs.

The tensile and compression testing apparatus used will be the Riehle screw machine at Purdue University, Lafayette, Ind. It has a capacity of 300,000 lbs., and it is fitted with an automatic beam of such dimensions as to allow tensile and compression tests to be made on specimens 8 ft. long and less, and permits of any length of draft rigging which can be used on a car.

Date and Places of Tests.—The drop tests will be made at Altoona, Pa., and the tensile and compression tests at Purdue University, Lafayette, Ind., and will begin Feb. 1, 1902.

Conditions for Entering Tests.—All draft rigging for drop tests shall be mounted according to the following specifications, and be delivered free of charge to Mr. A. W. Gibbs, A. M. E., Pennsylvania Railroad Company, Altoona, Pennsylvania, before the date mentioned above.

All draft riggings for tensile and compression tests shall be mounted according to the following specifications, and be delivered free of charge to Mr. William Forsyth, Purdue University, Lafayette, Ind., before Feb. 1, 1902.

Manufacturers entering draft rigging for tests shall submit, before Dec. 15, 1901, to J. W. Taylor, Secretary M. C. B. Association, 667 The Rookery, Chicago, blue prints showing detailed dimensions of the riggings they wish to have tested, etc.

On Dec. 27, 1901, a meeting of the committee will be held, at which time it will decide from the blue prints submitted what riggings will be tested, and each manufacturer will be duly notified. The submission of blue prints to the committee will be considered as approval of the plan of tests. As soon as possible after the receipt of notice from the committee of acceptance of draft riggings, manufacturers shall mount and ship to Altoona and Lafayette their riggings. Draft riggings received at either place after Feb. 1, 1902, will not be tested.

Specifications for Mounting Draft Rigging for Drop Test.—Manufacturers will be required to furnish one draft rigging complete already fitted to sills to suit the drop test machine at Altoona, as per drawings shown in Fig. 1. If wood sills are used they shall not be less than 5 x 9-in. oak, and if metal sills are used, they shall not be less than 10-in. 25-lb. I-beams.

Yokes shall be furnished of suitable dimensions to suit one or the other of the two sizes of coupler butts now in

use, and shown in Fig. 1. Manufacturers will not be asked to furnish dummy couplers, for the drop tests at Altoona.

The principal requirements in mounting draft rigging to fit the drop-testing machine are that provision be made for the two bolts holding the rigging in place, shown 11 in. either side of the center line, and 4 ft. 7 in. above the base of the machine; also that the rigging go between the guides as shown by the plan view, Fig. 1.

Specifications for Mounting Draft Rigging for Tensile and Compression Tests.—Manufacturers will be required to furnish two draft riggings complete, already fitted to sills to suit the tensile testing machine at Purdue University, as per Fig. 2 and Fig. 3. One rigging will be used for pulling, and one for compression test. From Fig. 2 it will be seen that the riggings may be attached to either 10-in. steel I-beams or 5 x 9-in. oak timbers, the spread varying from 9 to 23 in. for the steel, and 9 to 18 in. for the wood construction. In addition to the draft rigging, manufacturers will only be required to furnish the I-beams or oak timbers properly fitted, and the cast-steel dummy couplers. (Fig. 3.) The eye-bolts, pins, crossbar, rods and caps will be used in all the tests and furnished by the committee.

Drop Tests.—One sample of each kind of draft rigging approved by the committee, and properly mounted, will be required for the drop tests. For drop test purposes, draft riggings will be divided into two classes, as follows:

Class I, underhung draft rigging for cars with wood or metal draft sills where the draft attachments are not blocked between the body bolsters.

Class II, draft riggings placed between the center sills, and also cars where underhung draft attachments are well blocked to the body bolsters and well blocked between the body bolsters.

It is anticipated that different results will be obtained from the testing of these two classes of riggings. Riggings included in Class I will first be tested as applied to cars. If the fastenings begin to fail, then blocking will be put in between the attachments, and the anvil and the draft attachments will be tested to destruction. If necessary Class II riggings will be blocked in the same manner. If any part fails in the test, that part may be replaced at once, provided it is thought desirable by the committee.

In testing under the drop, the test will begin with a drop of 1 ft., and the height of drop will be increased by intervals of 1 ft., one blow each, until the rigging is destroyed. A tup of 1,640 lbs. weight will be used, striking the face of the dummy coupler. When parts are replaced, the test will be carried on from the point where the test was discontinued on account of the broken part.

Tensile and Compression Tests.—Two samples of each kind of draft rigging, approved by the committee and properly mounted, will be required for these tests. One rigging will be tested in tension and the other in compression. These tests will be carried to the capacity of the machine, 300,000 lbs., provided the riggings do not previously fail. Curves will be obtained, showing the relation between the load and the movement of the coupler. The load will be removed at frequent intervals before the draft rigging is injured so as to ascertain its condition and its behavior on release of load. The points at which any failures occur will be noted in detail. If any part fails in the test, that part may be replaced at once, if it is thought desirable by the committee.

The following definitions of terms were adopted for use in connection with the work of the committee:

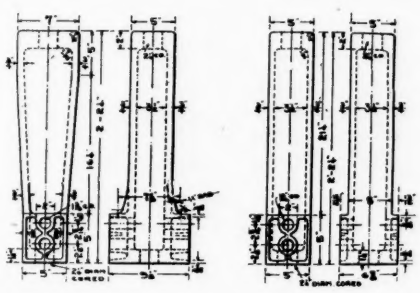
Draft Rigging.—A general term, implying the whole combination of draft attachments and coupler attachments.

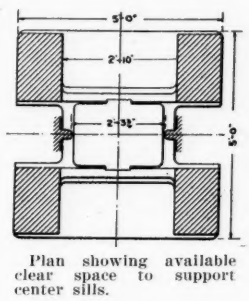
Draft Attachment.—The parts of the draft rigging attached to center sills of the car, including sill plates, carrying irons, etc.

Coupler Attachments.—The parts of the draft rigging attached to the coupler and included within the yoke, such as the yoke, springs and followers or their substitutes.

The committee does not consider that it is within its province to design attachments for manufacturers making only substitutes for springs. The attachments should be furnished of a design considered adequate by such manufacturers. It will be understood that the true names of the different riggings will be shown in the report, together with a full record of observations. The committee will provide draft riggings according to M. C. B. Recommended Practice, which will be used as the standard for comparison for all the tests.

The committee consists of: E. D. Bronner, Chairman; T. A. Lawes, Mord Roberts, George F. Wilson, J. F. Deems, C. M. Mendenhall, Wm. Forsyth, W. F. Kiesel, Jr.





Plan showing available clear space to support center sills.

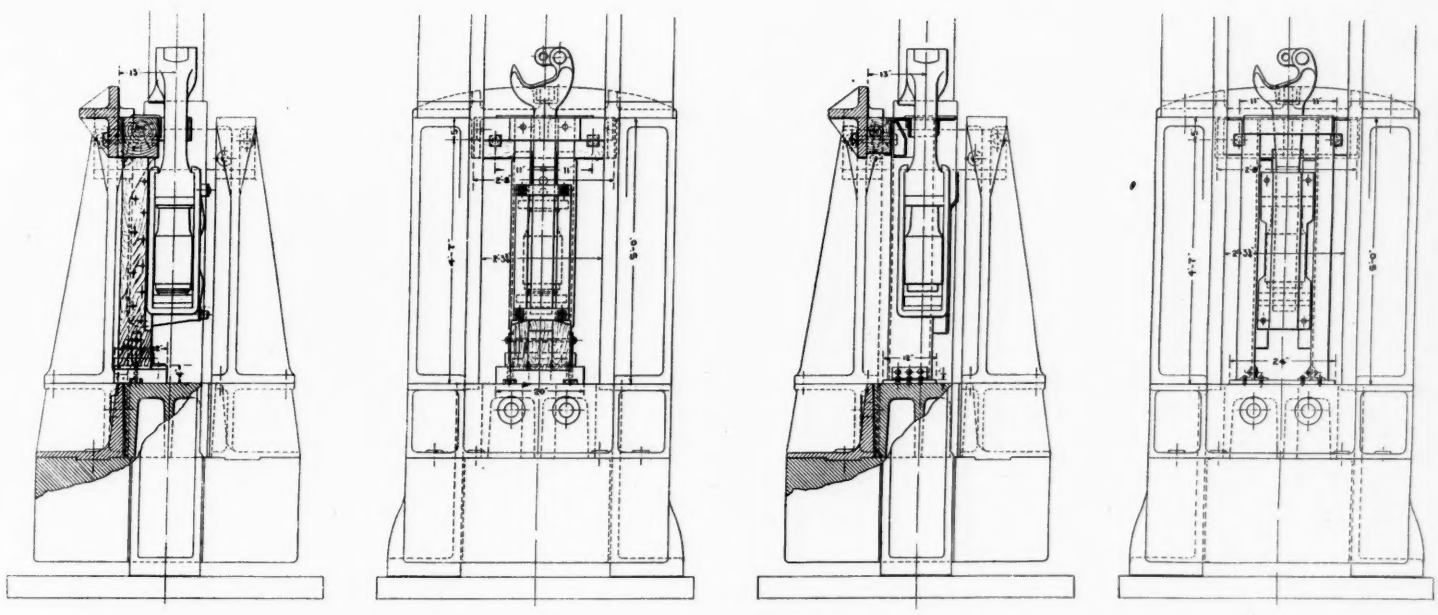


Fig. 1.—Method of Mounting Draft Gear for M. C. B. Drop Tests.

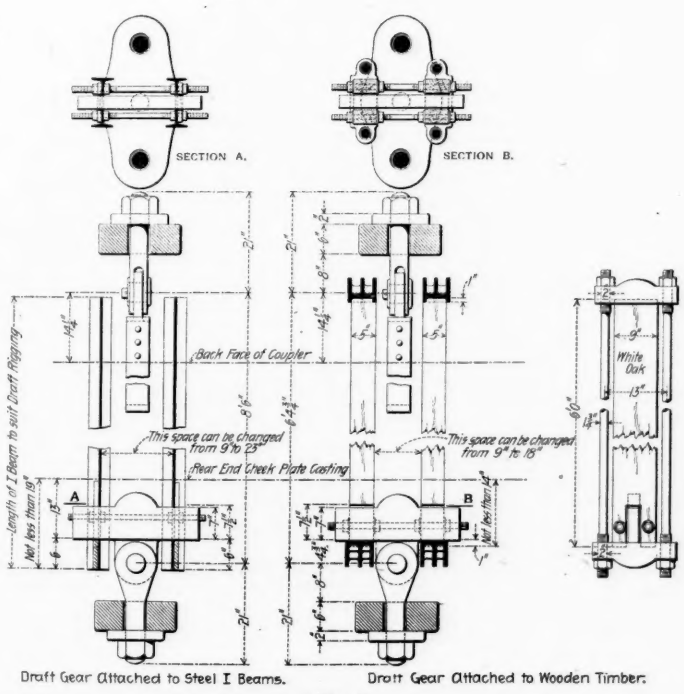

SECTION A.
SECTION B.
Back Face of Coupler
Rear End Cheek Plate Casting
This space can be changed from 9" to 23"
This space can be changed from 9" to 18"
Length of I Beam to suit Draft Rigging
Not less than 19"
White Oak
Draft Gear Attached to Steel I Beams.
Draft Gear Attached to Wooden Timber.

Fig. 2.

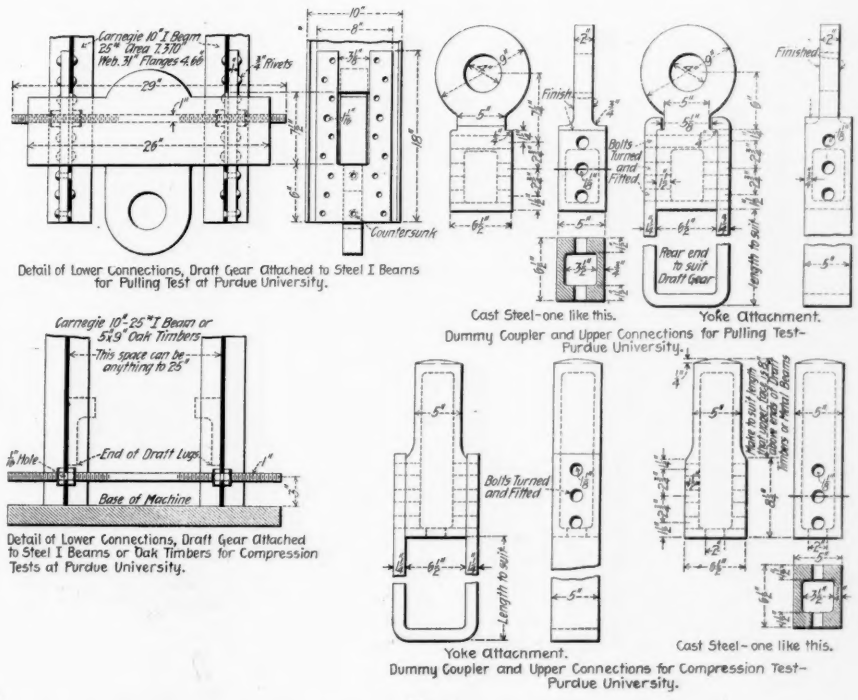

Carnegie 10" I Beam 25" Area 7.370 Web .31" Flanges 4.66
Detail of Lower Connections, Draft Gear Attached to Steel I Beams for Pulling Test at Purdue University.
Carnegie 10" 25"I Beam or 5x9" Oak Timbers
This space can be anything to 25"
End of Draft Lugs
Base of Machine
Detail of Lower Connections, Draft Gear Attached to Steel I Beams or Oak Timbers for Compression Tests at Purdue University.
Finish
Bolts Turned and Fitted
Rear end to suit Draft Gear
Length to suit
Cast Steel-one like this.
Yoke Attachment.
Dummy Coupler and Upper Connections for Pulling Test-Purdue University.
Yoke Attachment.
Cast Steel-one like this.
Dummy Coupler and Upper Connections for Compression Test-Purdue University.

Fig. 3.

Rigging for Draft Gear Tests—M. C. B. Association.

Interurban Electric Railroads in Southern Michigan.

From time to time we have described the development of the interurban electric railroad in various regions and recently mentioned those roads in Northern and in Southern Ohio.* The southern part of the State of Michigan is another favorite field for this development. Although there are not yet a great many of these roads in operation in that State there are a number of lines now building and still others are proposed of which the prospects for building seem good. There will soon be two through roads across the State and a through road north and south from Detroit.

The accompanying map will at once show that Detroit forms the most important center. The city is served by the Detroit United Railway, which will soon become part of a larger system, having recently gone into the control of the Everett-Moore Syndicate of Cleveland, Ohio, which controls many hundreds of miles of electric railroads. This syndicate is now building a line to connect its Michigan roads with its Ohio roads, and soon will have a line from Cleveland, Ohio, to Port Huron, Mich., with long lines extending east and west into adjoining states.

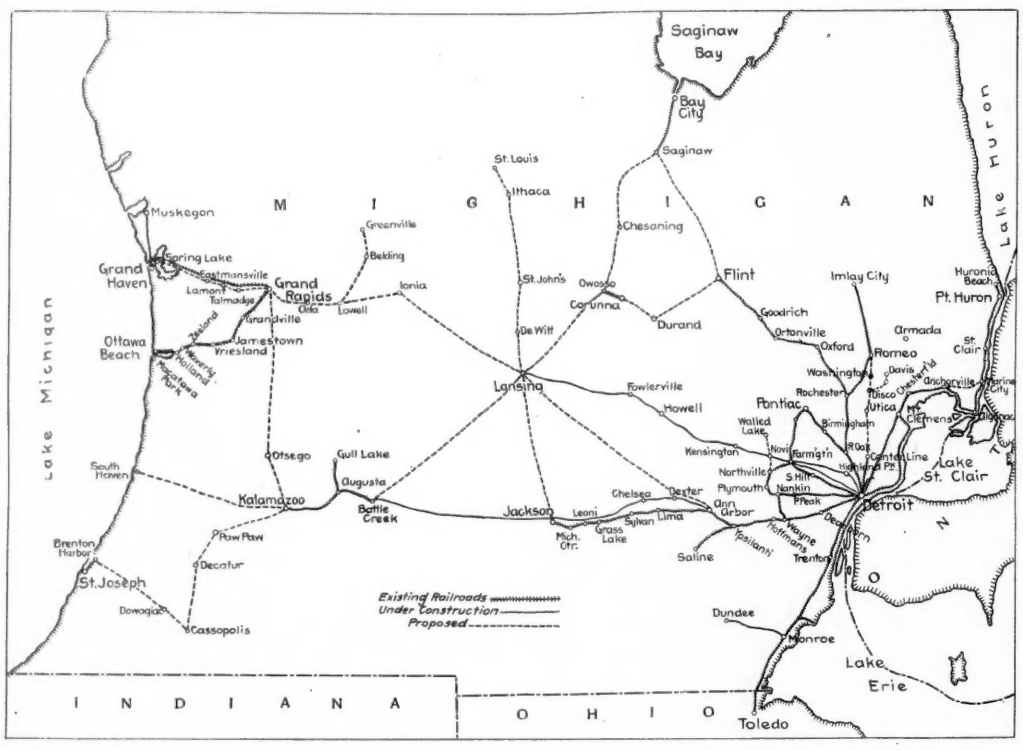
One of the important projects of the syndicate is the inter-state connection, the Detroit & Toledo Shore Line Railroad, originally intended as a steam road from Toledo to Detroit, a distance of 53 miles. Last April the syndicate bought the franchises, right of way, etc., of this Toledo-Detroit line and decided to build it as an electric road. At about the same time the Detroit & Monroe Electric Railway, a rival road partly built, was bought and consolidated with the Detroit & Toledo Shore Line. Building is now in progress and the road will soon be finished from Toledo north to Trenton, about 38 miles, where connection will be made with the Detroit United Railway's Trenton Branch, forming a through line from Toledo, 65 miles, to Detroit, through a section of country well supplied with steam railroads. The new road will be laid with 80-lb. T rail and the service for passengers will be frequent and fast, and freight will be handled in trains running on passenger schedule. A branch is building from Monroe to Dundee, about 10 miles.

The Detroit United Railway embraces all the street railroad lines, in and around the city, comprising about 365 miles of track. The Everett-Moore Syndicate has also bought the Detroit & Northwestern, which extends from the Detroit City Hall to Clarenceville, Farmington, Northville, Orchard Lake, Sylvan Lake and Pontiac, 38 miles, and it is now operated as the Farmington Division of the Detroit United Railway. It is double-tracked to Farmington Junction, 18 miles. Pontiac is also connected with Detroit by a more direct line, via Birmingham, which was built by the Detroit & Pontiac Railway, but now owned by the Detroit United and operated as the Pontiac Division.

Another road belonging to the syndicate is the Rapid Railway System, which comprises the following companies: Rapid Railway, the Detroit, Mt. Clemens & Marine City, the Port Huron, St. Clair & Marine City, the Detroit & Lake St. Clair, the City Railway of Port Huron, the Detroit & River St. Clair and the Rapid Railroad, the latter two being steam railroads. The system comprises a line from Detroit to Port Huron, and from Detroit along the shore of Lake St. Clair to Mt. Clemens, and the local street car system in the city of Port Huron. The total main line mileage is 107. There is a 10-mile cut-off being built between Anchorville and Marine City. The central power station is at New Baltimore. There are five sub-stations, namely, at St. Clair, Algonac, New Baltimore, Mt. Clemens and Roseville. A sixth sub-station is being installed at Port Huron. The entire passenger and express traffic is worked by electricity. Freight traffic is handled only between Chesterfield and Marine City, and it is handled exclusively by steam, it being confined to the Detroit & River St. Clair Railway, and the Rapid Railroad. In the city of Detroit the baggage is handled by the Detroit Omnibus Line Co.

There are no grade crossings on the line of the Rapid Railway System after passing the city of Detroit; the tracks are well laid and ballasted; the few bridges are substantial and every effort has been turned to the safe and speed running service. The cars are run on regular schedules under the supervision of a train despatcher—telephone stations being placed at all sidings along the line. Trains are run on the main line from Detroit to Port Huron every hour of the day and most of the night, and the time-table allows two hours and 40 minutes for the 74 miles.

North from Detroit also runs the Detroit & Flint Ry., composed of the Detroit, Rochester, Romeo & Lake Orion and the Detroit, Utica & Romeo, and owned by the Detroit United. The Detroit, Rochester, Romeo & Lake Orion does a general freight and passenger business, and, except in towns and cities, the road goes almost entirely over private right of way, running north through Rochester, Romeo to Imlay City, 57 miles; and from Rochester to Oxford and Flint, 43 miles. The company is now securing right of way for an extension further north to Saginaw and Bay City. This will give a line north and south almost across the Southern Peninsula, and give direct connection to Detroit for about 125,000 people in these towns and vicinity.



Interurban Electric Railroads in Southern Michigan.

NOTE.—*This Sketch Map does not show steam roads.*

The Detroit, Utica & Romeo Electric has only seven miles of road in operation but it is proposed to extend it north over the Center Line Road, passing several cemeteries outside the city limits, and run to Utica, Disco, Washington, and thence over private right of way near the Grand Trunk tracks to Romeo, the terminal. This makes 33 miles. One mile north of Disco a six-mile branch will be built east to Macomb and Davis. Ultimately the Davis Branch will be extended to Armada, about eight miles.

From Flint two connecting lines are proposed. The Owosso & Corunna Electric connects the two cities named and it contemplates building east from Corunna about 20 miles through Durand to Flint. An interurban road is building by the Saginaw Suburban Railway, which proposes to connect Flint and Bay City, via Saginaw, about 50 miles. Twenty miles are in operation. Bay City and Saginaw are already connected by the Saginaw Valley Traction, which also owns all the electric lines in Saginaw. In October of this year the Flint, Saginaw & Bay City was incorporated to build from Flint to Saginaw, a distance of about 34 miles, to connect with the lines already running from Saginaw to Bay City. Michael Brennen, of Detroit, is President of the new company.

The Saginaw Southern was organized about a year ago to build from Saginaw south some 40 miles through Chesaning to Owosso; thence to Lansing and Jackson. Such a line would practically parallel the Saginaw Division of the Michigan Central Railroad for about 100 miles. Surveys were reported being made during the summer and it is said the prospects for building are good.

Lansing will also soon become an important electric railroad center. At present the city only has a local road, but there are four distinct roads proposed to pass through the city and, when they are finished, tracks will radiate in seven directions, as shown on the accompanying map.

The Lansing, Dexter & Ann Arbor Electric will extend through the places named, about 60 miles, connecting with the Detroit, Ypsilanti, Ann Arbor & Jackson near Ann Arbor, making a through line of about 80 or 90 miles from Lansing to Detroit. The Lansing, St. John & St. Louis Railway has been incorporated to build from Lansing north 53 miles through Dewitt, St. Johns and Ithaca to St. Louis, and expects to begin work soon.

One of the most interesting interurban railroad systems in the State is the Detroit, Ypsilanti, Ann Arbor & Jackson Railway, known as the Hawks-Angus Company. In December, 1898, and in December, 1899, descriptions of the Detroit-Ypsilanti line of this company were given in the *Railroad Gazette*. This line closely parallels the Michigan Central Railroad through Dearborn and Ypsilanti to Ann Arbor, about 38 miles. It has a branch from Ypsilanti southwest 10 miles to Saline. An extension is building from Ann Arbor west through Lima, Sylvan, Grass Lake, Leonia and Michigan Center to Jackson. This extension runs over a private right of way in towns, and for the most part next to the highway. It was to be ready for operation through to Jackson by Dec. 1, 1901, making the road 100 miles long. There are now 92 miles of road finished but only 72 miles are in operation. An extension will be built from Jackson northwest, about 33 miles, to Lansing, to connect with the lines of the Lansing Street Railway (10 miles) recently bought. Another proposed extension, but not shown on our map, is from Jackson, southwest about 40 miles to Coldwater, for which right of way has been secured.

The Hawks-Angus Company is also building the Grand Rapids, Grand Haven & Muskegan, which is practically all graded from Grand Rapids to Muskegan, about 50 miles, and all but 13 miles of rails laid. The intention of the company is to connect Grand Rapids with Lansing (50 miles) and make a complete line across the State passing through a number of good towns and a good country. The work of securing the necessary right of way for this system is now under way and it is expected the line will be finished next year.

Part of the road between Grand Rapids and Lansing will be built by the Grand Rapids, Belding & Ionia Railway, which has been recently organized with a nominal capital stock of $100,000, by officers of the Grand Rapids, Grand Haven & Muskegan, Thomas F. Carroll, Counsel for that company, being President. The road will be built east from Grand Rapids and go through Ada, Lowell, the largest town in Kent County outside of Grand Rapids, and thence to Saranee and Ionia City, making about 25½ miles. Later the work of connecting Ionia City with Lansing will be undertaken, making a line across the State for both passengers and freight passing through a thickly settled district, highly prosperous in agriculture, horticulture and manufacturing. A branch of the Grand Rapids, Belding & Ionia will run from Lowell, 15 miles north through the city of Belding to Greenville.

There is a proposition on foot by the Detroit Construction Co., of which John Winter, of Detroit, is President, to build an interurban railroad from the city of Detroit northwest through Farmington, Howell, Fowlerville and Williamstown, and about 11 other towns, to Lansing, making a road 85 miles long. The name of the company is the Detroit, Howell, Lansing & Grand Rapids Electric Railway. A branch will run from Detroit through Highland Park and join the main line at Farmington. By an arrangement just made with the Hawks-Angus Company this road will enter the city of Lansing on the Lansing Street Railway tracks, and will not build to Grand Rapids. For about half the distance, or from near Brighton to Lansing, the electric road will parallel the Pere Marquette Railroad. There has been some work done on this line in the way of securing franchises and right of way, but otherwise nothing definite. Mr. Winter is President of the Grand Rapids, Holland & Lake Michigan Rapid Railway mentioned below.

Another important line from east to west in the State will be the Detroit & Chicago Traction, which, as its title indicates, has as its object an electric railroad between the cities named. The distance, according to the line of the Michigan Central Railroad is 284 miles. The Detroit & Chicago Traction Co. was incorporated in February, 1901, and is busy building the 120 miles of road between Detroit and Battle Creek. Much of the right of way, which, outside the towns, will be private, has been secured and the State Railroad Commissioner has approved maps of the proposed line, which require that all crossings of steam railroads shall be over or below grade. It is the object of the promoters of the Detroit & Chicago Traction to secure such urban roads as will be useful, and it has already the Jackson & Suburban Traction, the Detroit, Plymouth & Northville Railway and the Michigan Traction Company, which will form part of the system. The road, besides paralleling the Michigan Central, will closely parallel the Detroit, Ypsilanti, Ann Arbor & Jackson for most of the way from Detroit to Jackson. Several companies have in the past few months been incorporated to build sections of road for the Detroit & Chicago Traction.

The Detroit & Chicago Traction Company will pay

*See *Railroad Gazette*, April 26, and May 31, 1901.

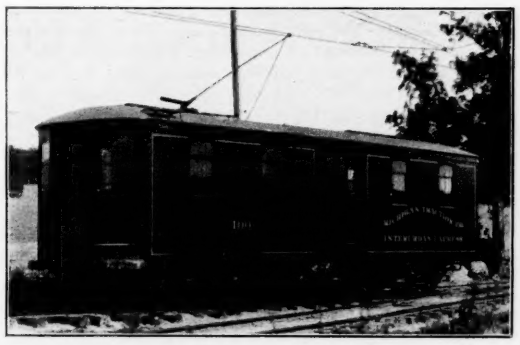
particular attention to freight, as well as give a fast passenger service. Of the acquired companies, the Detroit, Plymouth & Northville has about 16 miles of road in Wayne County, between Wayne and Plymouth and Northville, and will build an extension east from Nankin, into the city of Detroit to connect with the lines of the Detroit United Railway, with whom the Detroit & Chicago Traction has already made a trackage agreement. An extension will be built from Northville to Walled Lake. The Jackson & Suburban Traction is 20 miles long and it is being rebuilt. St. Joseph will probably be the objective western terminal in Michigan after the road passes through Battle Creek and Kalamazoo, though nothing definite can be learned about this. The principal power station will be in Jackson with sub-stations at Grass Lake, Chelsea, Dexter and Ann Arbor.

The Michigan Traction Co., owned by the Railways Company General of Philadelphia, will, as already stated, form part of the line of the Detroit & Chicago Traction. It is a consolidation of the Citizens' Street Railway of Kalamazoo, with 12 miles of track; the Citizens' Street Railway of Battle Creek, with 11 miles of track, and a 28-mile interurban line connecting Kalamazoo and Battle Creek. This interurban line extends through Comstock, Galesburg and Augusta and includes a 4-mile branch from

Combination Passenger and Baggage Car for Interurban Electric Railroad Service.

the main line at Augusta to Gull Lake, a large lake, where there is a summer resort. The road is carrying freight, having special freight cars built to suit the service. The freight is billed and forwarded by waybill on weight with all usual protection for shipper and carrier. The light freight and express is distributed and collected in the terminal towns by wagons owned and run by the company.

The interurban line is built on the side of the highway, except where it runs on its own private right of way. The overhead construction of the interurban road consists of two No. 000, figure-8 trolley wires, suspended 16 in. apart and equalized each 1,000 ft. The wire is supported throughout by bracket construction, except through cities and villages, where cross suspension is used. Only a small amount of feed-wire is required on account of the



Freight Car of the Michigan Traction Company.

use of alternating-current distribution and the use of two trolley wires. The bridges and culverts are steel and stone.

A telephone signal system is used. The wire is carried on the side poles. Stationary telephones are placed at each passing siding, and there are plug jacks on every fifth pole. These plugs are used instead of the usual fishing pole. Each car is also equipped with a telephone. The rules of the company in regard to despatching are strict. Each car crew not only has to call up the despatcher at each siding, but, on receiving his orders, both motormen and conductors have to write them in an order book provided for this purpose. Each man also signs the order book of the other so as to prevent any misinterpretation of the order.

The closed cars on the city division have 18-ft. bodies, are vestibuled, and are equipped with Westinghouse No. 3 motors and K-2 controllers. The open cars have ten benches and are equipped with Westinghouse 12-A motors and K-2 controllers.

The closed cars on the interurban division are of three types—combination passenger and smoker, combination passenger and baggage and straight passenger, built by the St. Louis Car Co., St. Louis, Mo. They are 45 ft. long, are mounted on St. Louis Car Company's 21-E double trucks with suspended bolster, and are equipped with four General Electric 1,000-h.p. motors and two K-12 controllers to each car. Christensen air brakes and whistles, Wagenhals arc headlights and Baker hot-water heaters complete their equipment. The open cars on the interurban line are 15-bench and double truck, and are also equipped with arc headlights. Both open and closed cars on the interurban line are equipped with stationary pilots. The freight cars (see photograph shown herewith) are 45 ft. long mounted on double trucks built by J. G. Brill Company, and equipped with G. E. 1,000-h.p. motors, K-12 controllers, Wagenhals arc headlights, the interior of cars being fitted with racks for milk cans. The cars are also built with doors at each end so material the length of the car can be loaded without trouble. A photograph is shown of a combination passenger and baggage car made by the St. Louis Car Co., similar to those used on this road for interurban service.

The power for the operation of the entire system is furnished from the Kalamazoo Valley Electric Light & Power Company's plant on the Kalamazoo River, 22 miles north of Kalamazoo. The current is led off on two circuits, one going to Allegan five miles west, and the other going to Kalamazoo and Battle Creek, respectively 22 miles and 46 miles, south and east. The first sub-station on the transmission line, where power is furnished to the electric railroad is in Kalamazoo. There are two 300-k.w. rotary converters installed here, one for power purposes, and the other for the railroad service. From the Kalamazoo sub-station the transmission line extends 24 miles to Augusta, midway between Kalamazoo and Battle Creek. At Augusta is a rotary station which, together with a rotary at Kalamazoo and one at Battle Creek, furnishes the power for the two city roads in Battle Creek and Kalamazoo, as well as for the interurban railroad between these two cities and the branch from Augusta to Gull Lake.

All the electric railroads in and about Grand Rapids are owned by the Grand Rapids Railway, which comprises 53 miles of track. There are several roads proposed in that locality. The Grand Rapids, Holland & Lake Michigan Rapid Railway began grading last fall on a double-track road from Grand Rapids southwest through Grandville, Jenison, Jamestown, Zeeland, Holland and Saugatuck to Macatawa Park and Ottawa Beach on Lake Michigan. The railroad consists of 26 miles of double track and 14½ miles of single track. There are 40½ miles of single track in operation and the rest will be built by May 1, 1902. The road runs through a prosperous farming country and will carry all classes of freight as well as passengers. The main power house is at Jenison, and sub-stations are located at Zeeland and Macatawa, where there is also a small reserve power house.

Mention is made above of a road to connect Grand Rapids with Grand Haven. The Grand Rapids, Spring Lake & Grand Haven Rapid Transit is also projected to connect Grand Rapids and Grand Haven with a line 31 miles long, passing through Tallmadge, Lamont and Eastmanville. The company has recently interested some new capital in its line, and it is said it will be built within a short time.

St. Joseph and Benton Harbor are already joined by trolley. The West Michigan Traction Company, capitalized at $1,000,000, was incorporated last July to build from the vicinity of Benton Harbor or St. Joseph southeast to Dowagiac, Cassopolis, thence northeast to Decatur, Pawpaw and Kalamazoo, in all about 90 miles. Two directors are C. O. Hadley, New York, and C. W. Haight, New Haven, Conn. Another road that will reach Kalamazoo is the Southern Michigan Traction Co., incorporated last summer to build from Grand Rapids to that city, making a 48-mile road passing through Otsego. It is proposed to build a road of most modern character, with some branch lines, and provide for both passenger and freight service. The company owns its own private right of way outside of the towns, and for a considerable distance in corporate limits of some of the towns, and the grades and the alignment will be such as to admit of high-speed service. Among those interested are A. D. Prosser, Detroit; Thomas Sherwin, Frank H. Green and others, of Cleveland, Ohio.

The distance between Kalamazoo and South Haven is 35 miles, air line. It is said final surveys have been made by the Grand Rapids, Kalamazoo & South Haven Traction Co. and some contracts let for the road between these two cities and to Grand Rapids. It is not known if the road will reach Grand Rapids from Kalamazoo, or from South Haven. Wm. H. Patterson, of Grand Rapids, is President. The Grand Rapids & Kalamazoo Electric is said to have let contracts for a road between those cities.

The Gordon Traction Co. has been incorporated to build an electric railroad from Battle Creek to Lansing, 50 miles. R. B. Gordon, of St. Mary's, Ohio, is President. Several other companies have recently been incorporated to build in the State.

The German Experiments with Extreme Speeds.

The experiments in running cars at extraordinary speeds on the Prussian Military Railroad were conducted by an organization formed for that special work and called the "Society for the Study of Fast Electrical Railroads" (Studiengesellschaft für elektrische Schnellbahnen). This Society has recently issued to the press a statement of what it has done and the result of its experiments to date, which may be looked upon as authoritative; and in consideration of the world-wide importance of the subject, we translate as follows:

"The experiments were begun early in September on the Royal Military Railroad. The trials with the two fast cars were made first with a locomotive, in order to test the cars and to adjust their several parts. After completing these preliminary tests, the runs with electricity were begun. Commencing with a speed of 60 km. (37 miles) per hour, this was increased progressively to 100, 120 and 140 km., and reached a maximum of 160 km. (99.44 miles) with a tension of the electrical current in the conducting wire amounting to more than 10,000 volts. Heretofore, a speed of more than 130 km. (81 miles) has not been reached on European railroads, and the highest reported on American roads has been 140 km. (87 miles).

"The experiments have been entirely successful and have given opportunity for important observations on quickness of starting and braking at the highest speed, on the visibility of signals, the consumption of power, air resistance, etc. The electrical conductors, the appliances for receiving the current, the electrical apparatus and the cars themselves have worked admirably, so that in these respects there seems to be no obstacle to attaining still greater speeds. On the other hand, the superstructure of the military railroad, though good and up to the standards, according to the observations made, seems insufficiently strong to meet greater demands. Before the experiments can be continued, therefore, for the sake of safety, a strengthening of the track and an improvement of the ballast are requisite. The extent and the manner of these improvements remain to be decided."

Steel Driving Wheel Centers.

At the November meeting of the Central Railway Club this was the subject of a topical discussion. We reprint the remarks of Mr. Player, of the Brooks Locomotive Works:

In our practice, in applying steel-wheel centers, we have always, in following our own design, made solid hubs, solid spokes and solid or uncored rims. We make solid hubs for different reasons; one, to get sufficient resistance of metal around the hub iself to withstand the pressure of application without imposing that pressure through the spokes to the rim as can be done in a cast-iron wheel where the spokes are of much greater section and capable of withstanding the resistance of that pressure; another, to give sufficient bearing surface on the axle.

In our small wheels we do not split the rims, but in our larger wheels, commencing with centers probably about 54 in. in diam., we split the rims in from two to six places. In some of the small wheels where we cast the counter-balances solid we split the rims either side of the counter-balance, on account of the distortion of the wheel, due to the unequal distribution of metal caused by casting so large a quantity of metal solid in the wheel, and also on account of the crank hub being so close to the rim on the other side, causing unequal distortion on that side also. In our long-stroke engine we frequently core out the portion of the metal between the crank hub and the axle hub in front, back, and intermediate wheels in order to prevent undue shrinkage of that hub at that point.

In keying wheels on the axle, for the main wheel we always use two keys placed about 22½ to 30 deg. off the center line. In the other wheels we use only one key. In some wheels, made to other's designs, having cored tubes, there has been trouble in keeping them tight on the axles. Especially is this the case when these wheels have a greater amount of dish than we think proper. In steel wheels with the light-section spokes that are employed, it is necessary to reduce the dish of the wheel to the minimum—in other words, the inside face of the spokes should be kept as nearly straight as possible because when we shrink the tire on, which is considerably heavier than the rim of the wheel, and the flange side of the tire being heavier than the outside, it has a tendency to draw the wheel in under any condition, and if a dish is put in the wheel in the first place, then it will draw the wheel out of shape and it will draw the crank hub, in fact, it will stretch the bore for the axle on the outside even and when you put that wheel on at a high pressure it will be more or less loose on the axle—that is a wheel with a cored hub. When you attempt to pull it off you can't get it off with three times the pressure that you use to put it on.

That is due to distributing the pressure on two points, you might say—the inside and the outside bearing-fits.

It is necessary in steel wheels to get as large a bearing surface on the axle as possible. In many of our large axles we increase the diameter of the wheel-fit, especially the main wheel, over that of the diameter of the journal, in order to give increased bearing surface on the axle. With solid wheels—that is, wheels with the hubs cast solid—we practically have no trouble from their getting loose on the axle. But, with cored wheel there has been more or less trouble.

Now, with regard to the cracking of steel wheels. Some trouble has been experienced with wheels of different patterns cracking in the spokes, more especially around the crank hub. That is due to a great extent to unequal distribution of metal, especially as the hub is a large body of metal itself and the fillets of the spokes are sometimes made insufficient to overcome the shrinkage strains set up at that point. In our later designs of wheels we have employed very large parabolic fillets, at the root of the spokes around the crank hub especially, and in wheels where the counter-balances are cast solid we have also used the same kind of a fillet around the spokes entering the counter-balance. We have always used the flat spoke wheel and the fillets of the spokes around the rim and where the spoke joins the hub have been of a parabolic form of large size.

Meeting of the American Society of Mechanical Engineers.

Last week we noted the opening of the forty-fourth meeting of the American Society of Mechanical Engineers and gave the President's Address. A report of the meeting follows:

At the first business session of the meeting on the morning of Dec. 4, the tellers announced that the election of officers had resulted as follows:

President, Edwin Reynolds, Milwaukee, Wis.; Vice-Presidents, Wilfred Lewis, Philadelphia, Pa.; M. E. Cooley, Ann Arbor, Mich., and M. P. Higgins, Worcester, Mass.; Treasurer, W. H. Wiley, New York.

The whole of this session was occupied with a spirited debate upon the proposed amendment to the constitution by which the annual dues would be raised from $15 to $25. Many proxies had been sent in, and as a result of the ballot, the motion was lost on a vote of 647 nays to 191 ayes, with 36 irregular votes.

The topical discussions were opened by one on the "Cost of Running High-Speed Trains," but nothing new

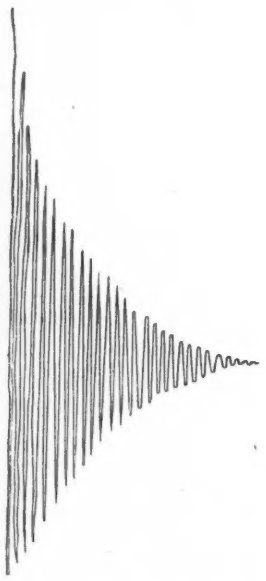


Fig. 1.—Diagram from coiled spring.

Fig. 2.—Diagram from Flat Leaf Spring.

was brought out. The matter was opened by a brief review of Mr. Delano's paper on the subject before the Western Railroad Club. The second topic was on the "Peculiarities of Springs."

It was opened by Mr. Stephen W. Baldwin, who said that when a coiled spring is put under a car or similar vehicle, the character of the loading or impact on the spring is often such that the load is suddenly applied, and then suddenly released. The tendency of the spring is to cause the body of the vehicle to "teeter," until the effect of the applied load successively compressing the spring and allowing it to release itself is diminished by the disappearing of the vibration. The flat, or leaf spring, as applied under carriages, locomotives, and elsewhere, by reason of the friction of the leaves upon each other, does not produce this same teetering effect, and for this reason is a preferable type. The room which the flat, or leaf, spring occupies, and its greater weight and cost, are the objections to its use. It would obviously, therefore, be an advantage if a coil spring could receive from without some effect similar to the friction of the leaves on each other, whereby an impedence of its oscillation could be caused, and its vibration could be either removed or diminished.

It has recently been observed by a firm of spring makers that a testing machine for springs could be devised whereby the application of the load upon a lever, which was counterbalanced by the spring, would cause that lever to trace the ordinates of a curve, the paper being moved transversely at right angles to these ordinates while the lever was vibrating. Fig. 1 shows the diagram from a coiled spring of the ordinary sort tested in this way. It would appear from the character of the diagram and the method whereby its lines were drawn, that the curve through the extremities of these ordinates should be of a hyperbolic form. The height of the ordinates appears to vary inversely as the abscissas which are proportionate to the times. The mathematical analysis which brings out this result is aside from the present purpose, but it will be apparent that the stiffer the spring the less will be the amplitudes of the vibrations, and that the greater the deformations the longer it will be before the spring comes to rest. It would appear, therefore, that as a spring lost its life, in the technical sense of that word, the form of the diagram would alter.

Two practical questions are therefore suggested by this method of testing and the diagrams which it presents. The first is: Can the adaptability of a steel for spring purposes, either as the result of its chemical constitution or its heat treatment, be inferred from the form of the diagram which it would give when tested by this method, and by the making of such a record? Second: Would the modification of the diagram caused by fatiguing a spring by and satisfactory indication as to the wisdom and adaptability of a certain manufacturing process or quality for springs? It is believed that the scientific question, resting so closely upon a practical basis, which is involved in the foregoing discussion, should bring out interesting results.

The diagram which is shown in Fig. 2 is a reproduction of the form of diagram from a flat, or leaf spring, where applied friction impedes the tendency to vibrate. Not only is the number of vibrations much less, but the time covered and the space passed over by them are noticeably less.

The further discussion hinged on the subject of spring dampeners. The matter was first called up by an allusion to the fact that the soft action of an elliptic or plate spring is due to the frictional resistance between the plates. Various forms of dampeners were mentioned, but the most efficient was considered to be the air or hydraulic cushion used on door checks.

One speaker stated that the results of his experiments with spring steel had shown that soft and tempered steel offered the same resistance to torsion, but that a greater twist could be given the tempered metal and still keep within the limits of elasticity. These statements were made positively but their accuracy was questioned by others who thought that tempered steel offered a greater resistance to torsion than soft steel.

It was thought that a steel low in carbon was preferable to a high-grade for spring purposes, and attention was called to the requirement that a permanent set is acquired by a spring upon first closing and that this set should not be increased by a repetition of the load.

A SILENT CHAIN GEAR, BY J. O. NIXON.

Many million feet of driving chain are made and sold every year. While the field in which this immense quantity of chain is used is necessarily very large, it is only a small part of the whole realm of power transmission. The reasons why chain gearing has been thus limited in its application are: The noise; the low speed limits; the increase of noise and jar due to the stretch and wear of the chain and the wear of the wheel. These three defects, inherent in all ordinary chains, are due to the stretch of the chain, by its elasticity and by wear, both internal and external, which make a chain, as soon as it is started up, too large for the sprocket which it was made to fit. The solution of the problem of producing a *high speed* and a *silent* chain gear lies in the production of a wheel and chain which shall always remain a perfect fit independent of the stretch of the chain. Such a chain gear has been developed by Mr. Hans Renold, of Manchester, England, and has been in wide and successful use in Europe for some five years past. This chain gear consists of a chain composed of links of a peculiar form stamped from the sheet or cut from a drawn bar fastened together by shouldered rivets into a chain of any desired width, running over cut sprocket wheels with teeth of a shape varying with the size of the wheel. It is absolutely silent and may be run at high speeds. It is capable of transmitting any amount of power from the smallest to the greatest. Another valuable property, which is a corollary of the self-adjusting feature of the chain, is the possibility of running two or more chains side by side on the same wheels. In this way, when large powers are to be transmitted, and the width of chain necessary becomes too great for convenience in manufacture or in handling, several chains may be used with the perfect assurance that each will bear its proper share of the load. A very small bearing will suffice, because the load is divided between all the teeth in mesh. Hence, to prolong the life of the chain, the steel used in its manufacture must be of the highest grade obtainable, and it must be worked with the utmost accuracy. A steel for the links of high tensile strength allows the use of pins or rivets of large diameter while preserving the tensile strength of the chain as a whole. The large bearing surface so obtained is rendered yet more valuable by the use of hardened pins of high grade material. The washers on the ends of the rivets claim no little attention. They must be small in diameter and not too thick. This necessitates a steel of high tensile strength and elasticity, so that the washer shall grip the rivet end when it is forced over it and still, by its small size, not add to the bulk nor detract from the appearance of the chain. The only factor so far found which serves to limit the speed is the difficulty of keeping the lubricant on the chain at very high speeds. At speeds exceeding 1,350 to 1,400 ft. per minute, the oil is thrown off by centrifugal force, but speeds as high as 2,300 ft. have been employed successfully by enclosing chain and wheels and running them in oil.

There was very little discussion on this subject. It was brought out incidentally that the designer of the chain at first insisted that no American steel could be found to meet the requirements of the work, but it is now being made of steel made at Cambria which is, in every respect, fully equal to the best foreign products.

In regard to the action of chain gears, it was claimed that it was less likely to jump than the regular Ewart chain.

COMPRESSION OF CAST STEEL AND CAST IRON.

After the regular technical work of the meeting had been finished Mr. Victorien, of the U. S. Ordnance Department, made a short address detailing some experiments that had been made at the Watertown arsenal preparatory to the designing of a disappearing gun carriage for a 13-in. gun, in which the load to be carried was 800,000 lbs., distributed over two rockers. The problem was to determine the proper width of rocker to be used and the crushing effect of this great weight. The blocks used were 12 in. wide, one scraped to a flat surface and the other to the arc of a circle of 144 in. radius. The steel casting used had a tensile strength of 75,000 lbs. and a limit of elasticity of 35,000 lbs. The cast-iron had a tensile strength of 30,000 lbs. Under stress the compression of the two metals was practically the same and amounted to .0047 in. for the cast iron, .0039 in. for the steel casting, and .0037 in. for forged steel.

Careful measurements showed that the compression extended at least 5 in. into the metal with a probability that it went through the whole mass. There was no disintegration of the metal under the load, but when the latter was removed it was found that the metal not only recovered but went beyond its original position, and gave a minus reading. It not only assumed this position immediately after the removal of the load but maintained it for at least 24 hours thereafter, and it is not known how long it would take for it to finally disappear.

The compression of the metal along the line of stress causes it to act after the manner of a rubber cushion and expand in a line at right angles to this stress. There is, however, a neutral point in this swelling located about ⅞ in. from the surface of contact, on each side of which the expansion grows gradually larger.

The porosity of the metal was demonstrated by the action on a piece of tissue paper placed between the surfaces. This paper showed a wider line of contact at the edges of the block than at the center, demonstrating the value of support in preventing deformation. On each side of this line of contact there was a band varying from ¼ in. in width, obtained under loads of 50,000 lbs., to 1.8 in. for steel and 2 in. for cast-iron under a load of 800,000 lbs. This band was caused by the oil that was squeezed out of the metal while subjected to this enormous pressure, and must have soaked into it at the time the block was being prepared. The load of 800,000 lbs. mentioned is the total load for the double rocker, but was actually only 400,000 lbs. for the single rocker 2 in. wide, as that is the limit of capacity of the Watertown machine.

The interest in these experiments lies in the fact that they have demonstrated the value of cast-iron to withstand those enormous loads without failure, and also as showing the flow and displacement of metal when subjected to excessive compression stresses.

Abstracts of other papers and discussions will be given in a later issue.

Test of a Corning Brake Shoe.

An interesting test of a Corning brake shoe, upon a 33-in. chilled wheel, has recently been made at Purdue University to show its frictional qualities. The test was made on the M. C. B. brake shoe testing machine by Prof. W. F. M. Goss under the specifications adopted by the Master Car Builders' Association last June. The results show clearly that a combination metal brake shoe, having a surface of part chilled and part soft iron, can be made to meet the Association's specification for friction. Such a shoe is known to wear as long as three or four plain cast-iron shoes.

The following extract from Prof. Goss' report describes the structure of the shoe in detail: "Its width is 3¼ in. and its length, as measured on the arc, 13½ in. It is cast about a single insert having five enlargements or lobes, after the manner practiced by the Corning Brake Shoe Co. The total area of the insert is 20.4 sq. in., while that of the face of the shoe is 43.9 sq. in. The insert, therefore, supplies 46.5 per cent. of the area of the shoe which is in contact with the wheel. The insert appears to be of soft iron and its effect is evidently to produce a chill upon the metal which is poured around it. In appearance, the insert after the test is of a dull color, while that of the surrounding metal shows the hard glaze of chilled iron. In examining the face of the shoe with a cold chisel, it was found that all parts of the insert were easily chipped, but that all other portions, excepting perhaps a very narrow line extending across the face near each end, were so hard as to turn the edge of a well tempered tool. While the narrow portions of the metal between the lobes of the insert were hardest, all parts of the face disclosed the well known characteristics of chilled iron. Prior to the test it was in full contact with the wheel. The shoe is preserved for record at the University."

The test consisted of stops made from a speed of 40 miles an hour under three different braking pressures. In Table I the average mean coefficients of friction given by this shoe are in one column, and in the other column are the coefficients required by the M. C. B. specifications for brake shoes tested on the M. C. B. testing machine under the conditions named.

Table I.

	Average Mean Coefficient of Friction. Per cent.	
Speed 40 miles an hour.	M. C. B. specifications.	Corning brake shoe.
Braking pressure 2,808 lbs.....	22	23.8
Braking pressure 4,152 lbs.....	20	20.6
Braking pressure 6,840 lbs.....	16	17.9

The specifications also provide that the rise in the value of the coefficient of friction at the end of the stop shall be within such limits, that the value of the coefficient of friction for a point 15 ft. from the end of the stop shall not exceed the mean coefficient of friction by

more than 7 per cent. The shoe tested showed increases as follows: Braking pressure, 2,808 lbs.; increase, 6.1 per cent.; braking pressure, 4,152 lbs.; increase, 4.7 per cent., and braking pressure, 6,840 lbs.; increase 3.5 per cent.

In his report Prof. Goss says: "Comparing the results of the tests with the specifications, it will be seen that the performance of the shoe exceeds the requirements of the specifications in every particular. The action upon the wheel appeared in every way normal. It did not score the wheel nor wear unevenly. No undue vibration was observed."

The record applications were in all cases made after the shoe had been fitted to the wheel by previous applications and after the machine itself had been thoroughly warmed to its work. To avoid any chance for repeated errors, it is customary in making tests at Purdue to make successive applications apply to different series and the sequence of the applications of these tests is shown in the first column of Table II. This table shows a summary of all results obtained from the record applications, the average of which only is given in Table I.

TABLE II. DATA FROM TESTS OF CORNING BRAKE SHOE.—CHILLED WHEEL.

Sequence.	Speed M. P. H.	Braking pressure, lbs.	Revolutions of wheel.	Length of stop, ft.	Time of stop, sec	Mean pull on shoe, lbs.	Mean coef. of friction. Per cent.	Pull on shoe 15 ft. from stop, lbs.	Coef. of friction 15 ft. from stop. Per cent.
3	40	2,808	108	1,025	32	647	23.0	850	30.0
6	40	2,808	101	868	28	676	24.0	850	30.0
9	40	2,808	98	833	28	692	24.5	850	30.0
10	40	2,808	105	970	30	673	23.9	850	30.0
Average	..	.....	103	924	29	669	23.8	850	30.0
2	40	4,152	75	651	23	852	20.5	1,050	25.3
5	40	4,152	73	631	21	847	20.4	1,050	25.3
8	40	4,152	74	639	22	874	21.0	1,050	25.3
Average	..	.....	74	640	22	857	20.6	1,050	25.3
1	40	6,840	54	465	16	1,178	17.2	1,440	21.1
4	40	6,840	57	486	16	1,198	17.5	1,450	21.3
7	40	6,840	53	445	15	1,308	18.9	1,470	21.8
Average	..	.....	55	465	16	1,226	17.9	1,453	21.4

Some Iron and Steel Statistics.

Last week in the department of New Publications we mentioned the fact of the issue of Mr. Swank's Annual Report to the American Iron and Steel Association for the year 1900, which report was presented to the members of the Association, Nov. 25, last. He finds that the total production of iron ore in the United States, in 1900, was 27,553,000 gross tons, being almost 3,000,000 more than in 1899. The increase was almost wholly in Michigan and Minnesota, and Mr. John Birkinbine is the authority for the figures. The shipments from the Lake Superior mines amounted in 1900 to more than 19,000,000 tons, or 68 per cent. of the total production of the year. Bessemer ore from Missabe ranged, in 1899, at from $2.25 to ton to $2.40; in 1900 it rose to $4.40 and $4.90, while in 1901 the range was from $2.75 to $3.00. Naturally other grades of ore had corresponding fluctuations.

The coal of all kinds mined in the United States, in the year 1900, amounted to 241,000,000 gross tons, as against 226,600,000 in 1899. These figures are on the authority of Mr. Parker, and we only give round numbers. The prices of steel rails for five years, including 1896 and 1900, were at the Pennsylvania mills, $28, $18.75, $17.62, $28.12, $32.29 in the respective years. The prices of steel billets in the same years were $18.83, $15.08, $15.31, $31.12, $25.06. No. 1 pig, at Philadelphia, was $12.95, $12.10, $11.66, $19.36, $19.98.

The production of pig iron in the year 1900 amounted to 13,789,000 gross tons. The increase in six years was amazing, the total product in 1895 having been 9,446,000 gross tons.

The production of Bessemer steel in the year 1900 was 6,685,000 gross tons, which was about 900,000 less than in 1899. In 1896 the production was 3,920,000 tons. The production of open-hearth steel is of course, interesting and important. In the year 1900 it amounted to 3,398,000 tons, while in 1895 it had been only 1,137,000 tons.

The production of Bessemer rails amounted in the year 1900 to 2,384,000, as against 2,271,000 tons the year before. Out of the total product of the year 1900, 602,000 tons was of 85-lb. section and upwards; 1,626,000 was between 45 lbs. and 85 lbs. Presumably in the year 1901 the 85-lb. section will be even a greater percentage of the total weight, but it will be observed that in 1901 they had already come to be about 25 per cent.

The Canal Treaty.

Below are the essentials of the Canal Treaty with England, as now before the Senate:

ARTICLE I.

The treaty shall supersede the convention of the 19th of April, 1850.

ARTICLE II.

The canal may be constructed under the auspices of the Government of the United States, either directly at its own cost, or by corporations, and subject to the provision of the treaty, the said Government shall enjoy all the rights incident to such construction, as well as the exclusive right of providing for the regulation and management of the canal.

ARTICLE III.

The United States adopts as the basis of neutralization the rules embodied in the convention of Constantinople, signed the 28th of October, 1888, for the free navigation of the Suez Canal:

(1) The canal shall be open to the vessels of commerce and of war of all nations observing these rules, on terms of entire equality, so that there shall be no discrimination against any such nation or its citizens or subjects in respect of the conditions or charges of traffic or otherwise. Such conditions and charges of traffic shall be just and equitable.

(2) The canal shall never be blockaded, nor shall any right of war be exercised nor shall any act of hostility be committed within it. The United States, however, shall be at liberty to maintain such military police along the canal as may be necessary to protect it against lawlessness and disorder.

(3) Vessels of war of a belligerent shall not revictual nor take any stores in the canal, except so far as may be strictly necessary, and the transit of such vessels through the canal shall be effected with the least possible delay.

(4) No belligerent shall embark or disembark troops or munitions of war in the canal except in case of accidental hindrance of the transit, and in such case the transit shall be resumed with all possible despatch.

(5) The provisions of this article shall apply to waters adjacent to the canal, within three marine miles of either end. [The usual provisions follow.]

(6) The plant, establishments, buildings, and all works necessary to the construction, maintenance, and operation of the canal shall be deemed to be parts thereof for the purpose of this treaty, and in time of war, as in time of peace, shall enjoy complete immunity from attack or injury by belligerents, and from acts calculated to impair their usefulness as part of the canal.

ARTICLE IV.

It is agreed that no change of territorial sovereignty or of international relations of the country or countries traversed by the before mentioned canal shall affect the general principle of neutralization or the obligation of the contracting parties.

A Steam and Hydraulic Electric Plant at Richmond.

The Virginia Electrical Railway & Development Company, which was organized in 1898 to supply Richmond, Va., with electrical power derived from the James River, has built a hydraulic power plant with a complete relay of steam engines and will presently supply current to the Richmond Locomotive & Machine Works, the W. R. Trigg Shipbuilding Company, the Richmond Traction Company, and other industries of the city. The power mains are about 70,000 ft. long and are laid in the main streets, the system being Edison tubes. The dam, 1,700 ft. long, 7 ft. 6 in. wide at the top, with a maximum height of 8 ft., and an average height of 5 ft., was built across the James River, and the water supply for the power house is drawn through a canal at the northern end of the dam and led 2,200 ft. down the river.

The dam is of concrete and because it is necessary to store water in the dry season there is an adjustable crest which serves this purpose but does not restrict the discharge during freshets. There is a pier built at every 40 ft. in the length of the dam, the piers being high enough to reach above the high water mark; and between these piers is a series of bays so hinged that the water pressure does not materially interfere with the operation of the crest of the dam. A light bridge runs the whole length of the dam, resting on the piers, and on it runs a truck with motor-driven machinery for raising or lowering the crest. The car is electrically driven and one man can adjust all of the crests very quickly.

The power-house is of artificial stone on a concrete base built 3 ft. above the high water mark of the river and on a level with the side walls of the canal. It is 112 ft. x 250 ft., and the total fall of water available at the power house is 25 ft., the turbines being in a chamber under the boiler room. The intention is to finally have 11,000 h.p. in 11 units. The turbines which are of the submerged horizontal type were made by the Stillwell-Bierce & Smith-Vaile Company, and the generators are General Electric, heavy railroad type, 750 k.w., direct current, 550-volt multi-polar, speed 110 r.p.m. Flywheels, weighing 80,000 lbs., are mounted on the armature shafts and these wheels are, of course, run whether the turbines or the engines are used for driving, arrangements being made for uncoupling when change is made.

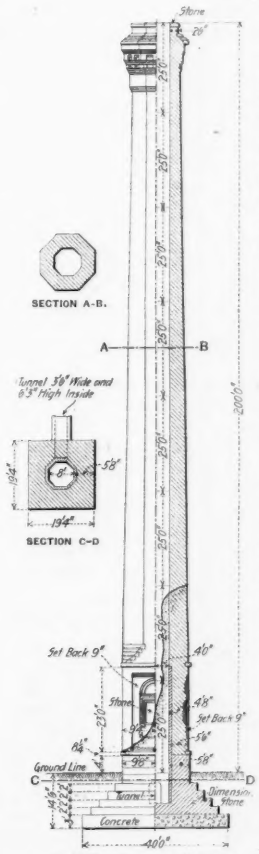
The engines are vertical, steeple-compounds with cylinders 20 and 40 x 42 in., built by the Allis-Chalmers Company and have Reynolds-Corliss valve gear driven by two eccentrics, and exhaust valves operated separately by special rods. The engines exhaust into a 36-in. header which leads to Worthington syphon condensers, of which there are two outside of the building. It was necessary to use two condensers, because of the great variation in the river level, one condenser being used when the water is low and the other when it is very high. The engines are built to work most economically at 800 h.p., with maximum capacity of 1,500 h.p.

The boilers are Babcock & Wilcox, of which there are six batteries of two boilers, rated at 500 h.p. each and capable of 50 per cent. overload, the working pressure being 150 lbs. per sq. in. Coal is brought into the boiler room on a trestle 9 ft. above the floor, the space below the trestle is used for coal storage, and the boilers will be fired by hand. Steam pipes are drained by the Holly system and the water is returned to the boilers. The plant is illustrated in *Power*, for November, and a diagram showing the relations of Richmond, the James River, and the hydraulic work is also given with a description from which we have taken this information.

A Chimney Failure.

BY WILLIAM WALLACE CHRISTIE, MEM. A. S. M. E.

In November, 1899, the Hoepfner Refining Company, Hamilton, Ont., began building an octagonal red brick chimney 200 ft. high with an octagonal flue 8 ft. in diam. of the inscribed circle, this diameter being the same from top to bottom. It was a single shell and at the pedestal the outside was square. The wall thickness at the top was 26 in. and at the bottom 66 in. at the thinnest part of the octagonal flats. The building of the chimney continued through the winter and the brick was laid in lime mortar. From freezing and thawing, variations in vertical alignment were found and reported and additional work was lined up to correct these changes. Another feature of the work that should be mentioned is the use of some large round boulders in the pedestal walls, some of which were laid bare within 4 in. of the outer faces of the wall when finally the chimney collapsed and the brick work slid off of these boulders. Early in April, 1900, when the spring thaw came, the chimney indicated collapse and the failure came at 1 o'clock a.m., April 18, 1900.



The chimney walls had no offsets such as are commonly used in similar structures. The collapse, by sliding down of the masonry, as shown in the ragged line of the illustration, did little damage to the sub-foundation and the limestone base which extended about 4 ft. above the ground. The flue inlet was below ground and the shaft had therefore not been weakened by it. It was decided to rebuild the chimney at once and the writer of this article designed the new chimney, and its erection was begun in June of the same year. The sub-soil was reported as blue clay and, the foundation and limestone work being in good condition, it was decided to repair the limestone base and build the new shaft upon it. The cross-section of the new chimney is circular and thus, with the same outside diameter at the base as the outside dimension of the original square base, and a smaller outside diameter at the top, a much thinner wall is used and a safe design obtained with a much smaller quantity of brick.

The exterior of the new shaft has three tapers, and the masonry is of common red brick, laid up in Portland cement mortar. At every 6 ft. in height an endless band of wrought-iron is built in the wall to bind it together, and the whole is capped with cast-iron, in six sections, upon which are secured six lightning rods connected to a band about the cap, and to a copper tape leading down the side to a charcoal bed in the ground. The fire-brick lining was laid up 35 ft. above the ground, 4½ in. thick, 8 ft. inside diam. and entirely independent of the shaft.

Comparing the original design with that of the new chimney we have:

Chimney.	Tons per sq. ft. on earth bearing.	Lbs. per sq. in. at base of brickwork.	Wall thickness. At top. Inches.	Wall thickness. At bottom. Inches.
Original.....	1.94	117	26	66
New.....	1.164	89.3	13	42

120 lbs. per cubic foot was used in calculations.

The new chimney was completed early in the fall of 1900. From the tabulation it is seen that by judiciously placing material much may be saved in careful designing.

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In these days while we are talking and thinking so much of exporting locomotives, bridges and other railroad and engineering material, it is interesting to read the opinion of a wise man as to the effect of this growing international commerce on the relation of the peoples. In 1894 Huxley was asked by the Arbitration Alliance to sign a memorial urging the government to co-operate with other governments in reducing naval and military burdens. After much meditation, he found that he could not sign it. "Not that I have the slightest doubt about the magnitude of the evils which accrue from the steady increase of European armaments, but because I think that this regrettable fact is merely the superficial expression of social forces, the operation of which cannot be sensibly affected by agreement between governments. . . . It is a delusion to attribute the growth of armaments to the exactions of militarism. The exactions of industrialism may, I believe, claim a much larger share in promoting that growth. . . . When I think of the intensity of the perturbing agencies . . . the attempt to counteract them by asking governments to agree to a maximum military expenditure does not appear to me to be worth the making; indeed, I think it might do harm by leading people to suppose that the desires of governments are the chief agents in determining whether peace or war shall obtain in Europe." Of course, there are two sides to this. Last year, when a great number of our fellow citizens were filled with indignation against Russia for discriminating against one of our products, and were ready even to threaten (if not to begin) war, another great number were in alarm lest we should break with Russia, and so close the doors to their wares; and so, perhaps, the exactions of commercialism counteract themselves. Still, we may have to fight to keep Manchuria open, and the German farmers and manufacturers do not love us—so we had better build some more war ships and coast forts and cultivate our artillery. This world-power business is troublesome and costly, and we must be prepared to bear its burdens.

The Safety of Passengers.

The disastrous collision at Seneca, Michigan, on the night before Thanksgiving calls public attention everywhere to the risks of railroad travel. These risks are infinitesimal when expressed in percentages and averages, and the individual passenger is assured, by statistics, that he is probably immune from fatal accident for several hundred years, however much he may travel in the cars. Not only this, the accident records have been free from great disasters for two years at a time, thus strengthening the hope that methods of railroad working are undergoing a radical improvement which shall prove permanent, and shall correct all bad practice everywhere. Marked improvements in regulations, in discipline and in the selection of trainmen have been constantly reported during the past few years, and on many roads; and the spirit of better service has become so general that one gains the impression that it has had its effects not only on roads from which specific changes in method are reported, but on all roads. Certainly the lessons of past disasters have been published widely enough, and if one could judge by what railroad officers say in public, he would be safe in concluding that they all know the art of safe railroading to perfection. Yet here we have another horror, a mistake in carrying out telegraphic orders, weak cars crushed by heavy ones, and passengers and trainmen burned to death before the helpless bystanders. Not even a burning hotel or a sinking ship can produce anything more terrible to the victims or more distressing to those who escape.

The only practical lesson that we know how to draw from collisions like this, and like the equally striking though less fatal collision at Franconia, Arizona, on the 20th, is that which is found in simple and well-known regulations which are shown to have been neglected in a particular case; and this lesson for the present occasion we discussed last week. We shall take it up again. In this place we only want to call attention to a feature of the records of the past which seems to show a very direct connection, on American railroads, between the safety of travel and the "pressure" under which the work is done. When business is light the passengers in the cars are comparatively safe; when it is heavy there is more risk. As we had occasion to point out in reviewing the accident record of 1894-7, a season of dull business is made safer by two principal causes—the percentage of experienced and competent trainmen is larger, and the complexity of the train movements is constantly diminishing instead of constantly increasing. Many competent observers would add a third important cause, the strain of overwork when business is heavy. Trainmen work too many hours at a time without taking rest.

The fact to which we refer is shown by taking the records of the five years ending with 1893, when business throughout the country was active, and comparing them with those of 1894-8 when business was dull. These are given in the table below. The number of passengers killed is taken from the *Railroad Gazette* record, the other statistics from the report of the Interstate Commerce Commission for the years nearest to the calendar years covered by our records.

Proportion of Passengers Killed in Train Accidents to Passengers Carried; Railroads of the United States, 1889-1898.

Year.	Passengers killed in train accidents.	Millions of passengers carried.	Millions of passenger miles.	Millions of train miles (pass. and fght).
1889.....	108	492.4	11,847.8	720.75
1890.....	172	531.2	12,844.2	754.20
1891.....	177	561.0	13,362.9	802.94
1892.....	116	593.6	14,229.1	844.34
1893.....	178	540.7	14,289.4	773.31
Five years.	751	2,718.9	66,573.4	3,895.54
1894.....	58	507.4	12,188.4	766.86
1895.....	38	511.8	13,049.0	812.35
1896.....	128	489.4	12,256.9	799.98
1897.....	62	501.1	13,379.9	845.29
1898.....	46	523.2	14,591.3	862.26
Five years.	332	2,532.9	65,465.5	4,086.74

Averages for Five Years.

	1889-93.	1894-8.
Passengers killed, per month.....	15.60	6.92
Passengers killed, per million pass. carried..	0.276	0.131
Pass'rs killed, per million miles traveled by passengers	0.0113	0.0051
Passengers killed, per milion train-miles...	0.192	0.081

The facts shown by these figures may be condensed into the simple statement that in the second five-year term the number of passenger miles was about the same as in the first five-year term, while the number killed was not half so large as in the first.

In the second period there were only two passenger train accidents of what we may call the first magnitude, and these were both in the same month (July, 1896, Atlantic City, N. J., and Logan, Iowa, killing 70 passengers). Excluding these, the average number of passengers killed per month would have been 5.46 instead of 6.92.

To reduce the dangers of traveling one-half in five years seems a remarkable accomplishment; but we are to remember that even if the Seneca collision had not occurred the low averages of the dull years would not have been maintained, for in 1899 there were 113 killed and in 1900, 112, and any spirit of boasting would be still farther subdued by a reference to the records of the English railroads.

In the United Kingdom in the five years, 1889-93, the number of passengers killed in train accidents was 149, and the number carried, excluding season-ticket holders, was 4176.1 millions. In 1894-98 the number killed was 69 and the number carried 4914.9 millions. This makes the comparisons with the United States appear as follows:

		U. S.	U. K.
Pass. killed per million pass. carried..	89-93	.276	.036
	94-98	.131	.014

Even if we take the single year of the English record which was the worst (1889) the average killed per million carried was only .113.

The great difference in the two periods in the British records is due to the Armagh collision in 1889, in which 78 passengers were killed. If the season-ticket passengers were added to the total carried, as should be done to enable us to make a fair comparison with American records, the English average would be very greatly reduced; enough, no doubt, to make traveling appear much more than ten times as safe there as here. The records of this country would, however, be considerably changed if the 180 millions of passengers carried yearly on the Manhattan Elevated were included.

The twelve train accidents in our record which are most prominent from the present point of view, are indexed in the table below. For the years previous to 1896 we have taken only those in which 50 or more were killed; for the past 11 months we have taken all of those which were fatal to a considerable number of passengers. The second column includes persons reported as fatally injured. These 12 represent only England and the United States, and only the past 25 years. Some of the most disastrous train accidents of the past dozen years—those killing the largest number of persons—have happened in Europe, Asia and Africa; and the worst which we ever recorded was in Mexico (in 1881, at the village of Mailpois, 214 killed).

Year.	Persons killed.	Place.	Kind of accident.
1876..	80	Ashtabula, Ohio.....	Bridge disaster.
1879..	73	Tay Bridge, Scotland....	"
1887..	85	Chatsworth, Ill.....	Butting collision.
1888..	66	Mud Run, Pa.....	Rear collision.
1889..	78	Armagn, Ireland.....	Cars ran back down hill.
1896..	47	Atlantic City, N. J.....	Crossing collision.
1900..	40	Tacoma, Wash. (electric).	Car fell down bank.
" ..	32	McDonough, Ga.....	Washout.
1901..	11	Bordentown, N. J., Feb. 21	Butting collision.
" ..	16	Cass, Ind., June 26.....	Washout.
" ..	16	Norton, Mo., July 10.....	Butting collision.
" ..	34	Nyack, Mont., Aug. 30....	Collision.

Some Thoughts About Per Diem.

And also a few facts. The reader will understand that it is the subject of rates for interchanged freight cars that we here refer to. Facts which can be called news are scarce in this field; but as the subject is important we make no apology for presenting speculations instead, especially as these come from prominent men. The American Railway Association Committee has begun to gather facts and will no doubt in due time present them to the world; in the meanwhile we summarize the principal features of two interesting letters recently published, one by Mr. W. E. Beecham, the car accountant of the Chicago, Milwaukee & St. Paul, and the other by Mr. W. A. Gardner, General Manager of the Chicago & North Western.

Mr. Beecham calls attention to the fact that in the matter of interchanged freight cars the interests of the two railroads involved are not always mutual. Sometimes a road is very desirous to rent its cars at a low rate, but cannot find a borrower; at other times it would prefer not to let cars even at a high rate, yet is compelled to send its cars away with through shipments. No one can tell whether, in the use of a per diem rate, the long journeys will balance the short ones. A car traveling a thousand miles at six mills earns six dollars. A journey like this can be made in six days; add two days for loading and two for unloading (total ten days), and at 25 cents the car earns $2.50, which is $3.50 less than under the mileage plan. But for a journey of 100 miles the earnings at 25 cents a day will be several times as much as at six mills a mile.

Mr. Beecham does not fear that per diem will lead roads to waste power in hurrying empty cars home too soon, provided the rate is reasonable. To adopt a per diem plan we must have, first, universal demurrage; second, united action. Demurrage rules ought to be stiffened six months before attempting per diem interchange. Mr. Beecham would allow some free time in interchange; the day of delivery and the day of return; and probably one additional day at each end. Time should be computed in even days, not by hours.

Mr. Gardner fears that per diem will not be a remedy for existing troubles. He would rather try the experiment of making every superintendent do his best under the present plan. It is not the railroad, but the public that is responsible for present

abuses. Much has been made of the decrease in average mileage per car since ten years ago; but this is due partly to the increase in the size of cars and to more accurate accounting methods. Accountants now include every car movement, including idle cars, cars going to the shop, etc. Cars carrying 30, 40 or 50 tons cannot be loaded (or unloaded) as quickly as ten ton loads used to be handled.

The North Western receives daily from other roads at Chicago, to be unloaded on its tracks in that city, 300 cars. These average eight days each on the North Western, so that constantly there are 2,400 cars at that terminal in this traffic. The business is not directly remunerative, and the question is, should the road be further taxed because it is so good as to thus accommodate the other roads? To make changes in the divisions of through rates, so as to make good to the terminal road the losses which a change would cause, would be only a temporary expedient, not permanently successful.

Mr. Gardner admits that some small roads, owning no cars, do a local business with borrowed cars, without permission from the owners; but, says he, a per diem rate is just what these fellows want. Mr. Gardner says that his road is not an obstructionist; he simply wants to make sure he is right before he goes ahead. If demurrage is properly collected from consignees and shippers, and if superintendents are made to do their utmost, the best practical results ought to be accomplished, without making the sweeping change proposed by the per diem people.

So difficult a subject cannot be dealt with in a column, or even in a page; but we may nevertheless point out one or two salient features here presented.

In general Mr. Beecham's position appears sound, but such a veteran should give us a more complete treatise on the subject. Who, better than he, can tell us just how to meet the thousand perplexing questions that are sure to arise? Mr. Gardner is a little too careful or, rather, his letter sounds excessively cautious. He and his fellow officers have never appeared to lack courage in the past, and the only thing required now is to turn that courage into this field. It is a large and difficult field, but there promises to be a large body of helpers.

The suggestions that free time will have to be allowed and that 50-ton cars will have to have rates different from those of 10-ton cars, indicate that the proposed change will make a great increase in the work of the accounting office. But why should this scare us? Can we expect to go on forever with a single rate for all cars, at all times and all places? The single rate is an attractive idea, but it will have to be given up.

"Bracing up" the practice of the demurrage bureaus is, indeed, a vital preliminary. Here, again, the idea of uniformity in rates should not be allowed to be an obstacle. Why charge consignees a dollar a day when 50 cents, or even less, might very likely get more service out of the cars? An essential thing in the relations with consignees is to convince them that store-houses on wheels are worth something. The demurrage bureaus have shown this to some consignees and in some degree, but there is room for much more work in the future than has been done in the past.

If the small roads (and large ones) that steal car service think to convert their trick into an honest one by paying 25 cents a day for cars, there is a remedy in the "sliding scale." It cannot be that this is an unsolvable difficulty. A higher rate after the 5th or 10th day would be worth trying even if the plan should break down a few times. The same with the plan of giving the terminal road a larger share of the revenue; if the first trial develops friction the lessons of experience must be made to yield new expedients.

In short, the proposal to pay for cars by the day instead of by the mile must be supported, because it is the only way to introduce business methods, and therefore is the only just way. With mileage, no lender can check the borrower's accounts; with per diem the checking is perfect and automatic. To introduce justice (for the first time) into such an important department of railroad dealings may well justify a large increase of clerical expense as well as a hard campaign of education.

The Mechanical Engineers.

The annual meeting of the American Society of Mechanical Engineers, which closed on Friday last, was one of unusual significance, both because of the large attendance of members and the importance of matters which had attention. President Wellman's address upon the Early History of Open-Hearth Steel Manufacture in the United States (which we abstracted at length last week) was all that his friends could have wished it to be. The professional papers, while not more numerous and while on the whole somewhat less formal than usual, served as texts for many well-conducted and profitable discussions. The dedication of the Robert Fulton memorial, erected by the Society in Trinity Churchyard, was marked by the attendance of many distinguished engineers, and was observed by a simple but impressive service.

While other events should not be undervalued, it is but just to say that the interest in the meeting centered in the business session of Wednesday morning. Chief among the questions to receive attention was that with reference to an increase of dues. The Council had proposed that full members, who now pay $15 annually, should hereafter pay $25, and that the Juniors and Associates should be correspondingly increased. The question came up as an amendment to the by-laws and was to be settled by a two-thirds vote of those present, either in person or by formal proxy, and as the discussion proceeded, it became evident that negative proxies in the hands of members far outnumbered members in attendance, many of whom were opposed to the proposition. By the report of tellers, the proposition was lost by a vote which was aproximately four to one.

The proposal to increase the dues had not been favored by enthusiastic support from any quarter, but, on the contrary, had been vigorously assailed by the press and by groups of members, some of whom were organized to secure proxies against it. The Council meanwhile appears to have made a weak case in its efforts to secure converts. It was generally understood at the time that notice of the proposed amendment was given that its purpose was to permit the Society to finance some scheme for a new Society house, though, we believe, formal announcement to this effect was never made. In its recent discussion of the matter in circular letters issued to members the Council has made no mention of the house matter, an increased income being urged as necessary for general purposes. The specification in detail contained items, some of which were regarded as trivial, while the others appear to have been insufficient to justify the proposed change. During the discussion of the matter Wednesday, some members advocated and others opposed the measure. Under pressure of debate it became evident that the Council was not thoroughly informed or agreed concerning the financial need of the Society. The discussion was protracted, and while characterized by great earnestness and frankness, there was no evidence of ill feeling. The high plane upon which it was maintained is a tribute to the dignity of the Mechanical Engineer.

The matter having thus been settled, it now remains for the Council to get itself together and find out exactly what the present situation is, and arrive at a clear estimate as to what the future need may be. Many members believe that when this shall have been done, and when reforms in administration which will then be found possible and desirable shall have been made, that the present income will be found sufficient. If it should not prove sufficient for an efficient administration of the Society's affairs, it was clearly the sentiment of the meeting that the Council should not hesitate to present a new proposition in such form as would serve its necessities. Meanwhile the high character and professional eminence of the members of the Council, and the necessity for conservative action which the present situation imposes upon them, may be accepted as a sufficient guarante that the privileges of individual members will be carefully guarded and that the larger interests of the Society will be fully served.

On the 14th of November last was celebrated the fiftieth anniversary of the opening of the railroad between St. Petersburg and Moscow, the first commercial railroad in Russia, which was built by Ross Winans, of Baltimore, The Russian newspapers recall the opposition to the railroad at the time it was proposed, which it required all the firmness of the Czar to overcome. A certain Narkis Oreschkoff, who was a member of several scientific societies, distinguished himself by his "demonstrations" of the impossibility of building the road and of its uselessness if built. On the short Manchester Railroad, he said, trains were sometimes a whole day behind time; therefore on the 400 miles between Moscow and St. Petersburg, they would be 30 to 40 days behind time. The assumption that the railroad would lessen the cost of provisions in the two great cities at its termini was absurd; because only at these termini could freight be received for transportation. It was proposed to charge only $25 for passage over the road; this would ruin it directly, for the learned Oreschkoff had made an accurate calculation and found that the cost of transportation would amount to $251.50 per passenger, so that there would be a loss of $201.50 for every one carried. Under the most favorable circumstances the railroad could count on carrying only 126 tons of freight and 8,000 passengers yearly. This must have been about 1845, when there were already thousands of miles of railroad in successful operation in Europe and America. Yet arguments like these had such weight with men in high place that a committee of ministers of state reported against the project by an overwhelming majority. This railroad, in 1900, carried 4,252,000 passengers and 6,792,000 tons of freight, and it is now proposed to lay a third track. As early as 1852 its net earnings were $850,000; in 1900, $8,327,000.

A press despatch from Washington says that as the result of a consultation between President Roosevelt, the members of the Interstate Commerce Commission, and officials of prominent railroads and influential men in both houses of Congress, a brief bill is being prepared designed to carry out the recommendations of the President's message for the passage of an act amendatory of the Interstate Commerce law. Chairman Knapp has undertaken the task of preparing a bill and, according to the despatch, a basis of agreement has been reached between him and the presidents of important trunk lines. The despatch is rather hazy in regard to details, but the purpose appears to be to prepare a "brief" bill which, in its chief feature, shall be the same as the Cullom bill; that is, a bill requiring the railroads to obey the orders of the Commission pending any appeal which may be taken to the courts.

Economy in Locomotive Service.

BY G. R. HENDERSON.*

(*Concluded from page 835.*)

Lubrication.—The next item of expense, lubrication, is the smallest of the group; however, on large roads the cost will run over $100,000 per year. Perhaps the greatest loss under this heading is due to waste of the oil. We are all familiar with the pools of oil on tracks and roundhouse floors, and on parts of the machinery not needing lubrication. The opinions of different engineers as to how much oil should be used will vary widely. This is generally reported on an engine-mile basis, but we believe the ton-mile is more nearly correct, as a large engine surely requires more oil than a small one. If engines are grouped so that those operating in one district are similar in size and type, the average of the best third or half may be taken, and *all* required to keep within this rate or explain why. The plan of limiting the quantity of oil placed on the engine has objections; it may be particularly embarrassing in case of a hot journal. But if plenty of oil is carried, but only the allowed amount used, both points are satisfied. It is not good policy to skimp oil and sacrifice coal and repairs thereby, but this is no doubt often brought about by a determination to cut the oil record regardless of consequences. Perhaps 25 miles to a pint of engine oil and 100 miles to a pint of cylinder oil are about as good as can be expected from a large locomotive. Any cases of extremely cheap lubrication should be causes for suspicion and investigation.

Engineers should be charged with and held accountable for all issues of oil except such as are applied to boxes in the roundhouse and shop. If the cans are kept with the engine they may be weighed on return from trip and filled before starting out, the loss in weight or measure being the consumption for the trip. Much can be done to reduce oil consumption by providing proper cans, proper oil cups, and proper conveniences and accessibility. Cans that are broken and leaking should promptly be repaired or scrapped, and suitable oil cups should be applied where lubrication is necessary. Sometimes a cup, ordinarily out of sight, can be made visible by means of a pipe extension, and such parts as eccentrics and links, which, in the modern engines with high wheels, are difficult of access, should have oil cups to accord with the situation. The traveling engineers can do much to see that the engines are lubricated properly but not wastefully, and if the practice of selecting such road foremen from their records, considering fuel and oil, as well as freedom from wrecks, is in force, we can hope for good results.

Often fast trains are oiled out of all proportion to their needs. One case is in mind, where the "fast mail" used three times as much as the average of the group. Systematic and intelligent lubrication, and a proper realization of the needs therefor will produce the best results, and should be the goal continually sought.

Enginemen.—The charge for engineers and firemen is the next in order of size to the fuel bill; unlike the coal and oil accounts, the charges for which are for material almost exclusively, this is a labor charge. At the outset it may be said, that as a general proposition, economies in the labor accounts should not be sought by reductions in the individual pay of the men. Nothing creates so much discontent as to arbitrarily cut the pay, and with this discontent all other accounts will suffer. Cheerful co-operation will count for much in the matter of economical operation.

At first sight, we may think that we are thus prevented from making decided savings in this line, but as freight charges are made on the ton-mile basis, and the enginemen paid on the mileage basis, if we are able to increase the ton-mileage without increasing the engine mileage, we will accomplish our desire. To this end old and light power should be abandoned, and modern engines placed in service. As an illustration of the benefits of this practice, it was recently computed that for a southern road, with many 1 per cent. grades, but equipped with light engines, that if provided with suitable power, a saving of $300,000 a year could be obtained. This improved service could be made with 20 modern engines at a cost of $15,000 each, or a total of $300,000, so that the cost of the engines would be made up in the first year's operation. It is unnecessary to add that a very broad-minded policy is not required to appreciate the benefits from the above-mentioned substitution. It may be asked if too large a locomotive can be purchased, and in general we should answer that the engine should be as heavy as the track will stand. Even if the business at the present time seems to be insufficient to load such an engine to its full capacity, an increase may generally be

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looked for. If the heavy power is uneconomically loaded, as far as coal is concerned, the cylinders may be temporarily bushed, thereby causing economy in the use of steam, and when traffic demands, the bushings may be withdrawn and the engine is ready to do its full work.

After the larger locomotives are put upon the road, however, the real problem commences, and that is to keep them properly loaded. The tonnage rating method is now well established on all important roads, but even on many of these it is not as correct or satisfactory as it should be. Carefully prepared tables worked out by calculation and checked by practical tests for the different classes of engines over different portions of the road are essential for this purpose, and intelligent allowance for empties, fast freight service, weather, etc., is equally necessary. The allowance for empties must vary with the rate of gradient, and if it is desired to obtain the full benefits, then partially and lightly loaded cars must also be treated properly. Various treatises have appeared from time to time on this subject, so that any who will can obtain the benefits of this method.

After the proper loads are established, vigilance is required to see that these loads are hauled. Daily reports, showing the percentage of tonnage actually hauled in each train to the allowed tonnage, afford a check in the making up of trains and enable the superintendent to apply the necessary remedy when a fair load is not pulled. Engines must be maintained in good condition, and when it is claimed that they will not pull their tonnage, the reasons must be investigated. Overtime is always a dead loss, and the despatcher can keep this down to a minimum by carefully arranged meeting points, provided, of course, that there are side-tracks sufficient to handle the business. If there are not, the cost of such sidings can quickly be lost in overtime. Overloading engines will cause overtime and doubling hills, and is often brought about by over-zealousness on the part of the superintendent in order to make a record for tonnage. Overloading is particularly hard on the engine, coal pile and the men, as it causes delays and men tired out before their run is over. The custom of overloading compound locomotives, so that a large part of the time they must work as simple engines should certainly be decried. The extra expense of compounding is entered into in order to save fuel. When the engine is operated simple a waste of fuel results, and then we have the apparent anomaly of the compound consuming more coal than its simple companion. Delayed time can be prevented by taking care not to call the crew until the train is known to be ready or will be beyond probable doubt, but sometimes emergencies arise at the last minute which cause delays.

Constructive mileage cannot always be avoided, on account of the physical condition, location of important stations, roundhouses, etc., generally too close together and brought about by property acquired subsequent to the construction of the parent road. Judicious handling of this point by the master mechanic, however, can often reduce this charge, sometimes by adding a short local run at one end, in order to bring up the daily mileage. For economical handling of trains, both freight and passenger, it seems as if divisions of 150 miles were almost ideal. The time of passenger trains —about four hours—makes a round trip per day possible by double-crewing the engine, thereby allowing the men to make 4,500 miles per month, and the engine 9,000 miles. Freight trains would require about 10 hours time and the men would not become tired out, nor the fires too dirty to steam properly, which is a constant trouble with poor coal and long runs. With oil as fuel the engine can run almost indefinitely, but the men must be changed.

Hostlers and Wipers.—Hostling and wiping generally takes a small share of the expense, and is nearly dependent upon the number of engines cared for regardless of their size or mileage. In order to maintain a low cost on the revenue basis, therefore, the engines should be large and should make a liberal mileage between housings. The terminal facilities are also responsible for much of this charge. Turntables operated by power have been known, at busy points, to enable a smaller number of hostlers to handle the same number of engines, and improved ash-handling apparatus will often produce a nice saving. The number of engines handled at the point in question, however, must be sufficient to warrant the expense of these installations; otherwise there may be no actual economy resulting from the installation, as the same number of men may be required. An electric turntable motor at a Chicago roundhouse, where 400 engines per day were turned, effected a saving of $200 a month, and an automatic ash elevator at Clinton, Iowa, saved over $100 a month. If less than 40 engines a day are handled, however, a careful investigation should be made before incurring the expense of the apparatus.

Wiping engines is looked upon by many as a luxury. The writer, however, does not share these views. In hundreds of cases a careful wiper has discovered cracks and defects that would undoubtedly have caused engine failures, if not wrecks, had they gone unnoticed. No stationary engine, even if worth but $1,500, is allowed to work in the condition in which we see many $15,000 locomotives; but because an engine has to work in the dirt there seems to be a tendency to leave it dirty. If anything, there exists a greater need for the cleaning. One man can wipe three or four engines a day, cleaning rods, wheels, machinery and parts below the running board. The cost need not exceed 35 or 50 cents, and should never be begrudged for passenger locomotives. With a large road, having 1,000 engines, the cost would run from $300 to $500 a day for wiping, but the value of the machinery cared for is in this case $12,000,000. It seems to be a question that each one must decide, how much wiping is economical.

Roundhouse Labor.—Roundhouse labor comes between the last account and shop repairs. The running repairs of a locomotive, while generally light in nature, are fully as important as any work done in the shops. If these are neglected, we have engines which may be poor steamers, have valves out of square, pounding brasses and boxes or hot journals, and which bother the operating department so that the engine is dreaded by men and officers alike. These expenses will naturally vary with the ton-mileage—that is, the size of engine and distance traveled. When the business falls off the amount of running repairs, wiping, etc., should also fall off, but in busy times these are bound to increase. By having this work done carefully and thoroughly the greatest economy can really be practiced. Engineers should be required to report the condition of engines on arrival, even if no work is necessary. The foreman should *know* that all *necessary* work is *done*. This calls for the exercise of judgment on his part, as some engineers continually report insignificant matters as a sort of a "fad" and which might entail expense entirely incommensurate with the needs. Generally, roundhouse work can be better done by having certain men for air pumps and brakes, others for valve motion, others for rods, etc., and if the house is large enough to warrant it, the work is apt to be better performed.

In connection with this subject, it is often advisable to be sure that the engineer who takes an engine out is posted as to a filed brass or a new driving box, that he may give it especial attention. In such cases it has been found that a tag tied to the throttle lever, stating the particular object which has been repaired, has given good results by thus notifying the engineman.

Roundhouse appliances should be such that the running repairs may be done economically. A good drop pit and jack are indispensable for removing wheels. The "blow-off" water should be conducted in pipes to the sewer, so as to keep the house free from steam and not interfere with the workmen. Air pressure should be supplied for operating small motors, and the building should be well lighted at night. In winter, a blast of warm air should be turned into the pits, in order to quickly thaw out the frozen engines and make repairs quickly possible. The pits should be well drained and comfortable for the men. No work is more important than roundhouse work, and that house which is most comfortable and has the greatest facilities and conveniences will come out ahead in quantity, quality and economy of work.

Repairs, Renewals and Supplies.—The item of repairs, renewals and supplies is the third in order of expense, and as it is made up of two factors, labor and material, it permits of more latitude of control. Good judgment is especially necessary here, as small items and expenses, in themselves insignificant, grow to large proportions under the continual multiplication called for by a large number of engines. It would be impossible to deal with this problem in more than a general way, but some points will be given which may prove of interest.

In the first place, the engines, unless damaged in a wreck or collision, should not be sent into the shop until a proper mileage has been made. What this is depends largely upon conditions of the road, etc. We should say that freight engines should make 80,000 miles, and passenger engines 120,000 miles, between general repairs. It is not economy to allow an engine to run in such condition that failures are repeatedly made or coal economy sacrificed owing to needed repairs, but shoppings on short mileage should be questioned. Careless road or roundhouse attention may be the cause of frequent shoppings. General repairs, costing $1,000, would mean 1 cent a mile for 100,000 miles made, and the running repairs must be added to obtain the total cost of repairs. The same repairs on 50,000 miles will run the cost up 1 cent a mile more.

Having brought the engine into the shop, it should be economically handled. It is well known that the longer an engine is in the shop the more it will cost, chiefly due to the fact that the ordinary shop man has little conception of the value of making accurate distributions of labor and to the tendency to find work to do as long as the engine is in. We believe it economy to have fewer engines in shop and to keep them in a shorter time; this also requires less shop room, and enables the machine to be sooner put back in service, to "earn its living." Scheduling the work beforehand, and providing each department with a date for the several important parts, assists greatly in developing this plan, and insures the smooth and uniform progress of engines through the shop. This is especially the case where new work is done in connection with repair work.

In order to make repairs cheaply the shop must be fitted with such appliances as cranes, air or electric portable motors, and machinery of proper proportions for the work. Many of the tools sold for this purpose a few years ago are now worthless, as they are not able to perform heavy work. There is no economy in maintaining such tools in use, and they are worth more as scrap. With the proper tools and appliances, discreet management must be necessary to see that the tools are worked to their capacity. Tool steel is now produced that will remove wrought iron at 70 ft. a minute, and hard steel at 30 ft., and by providing the foreman with rotameters (a small pocket instrument for measuring the cutting speed) it is possible for him to make sure that the proper speed is maintained. Much can often be gained by simply running the shafting at a higher speed, and it is certainly more inspiring and conducive to life in the shop. The proper organization of gangs for various purposes is only one of the many problems presented to the foreman, so that high-priced men may not be found doing a low grade of work. The gradual advance in rate of the men from lower to higher wages, as they attain proficiency, and as the older men leave or are promoted, serves to encourage the younger members, and afford contentment without increasing the rolls. The transportation of shop material is always expensive if done by hand, and if the shop is large enough to warrant a traveling locomotive crane, it will be found a good investment.

Much can be saved by the judicious use of malleable iron or cast steel in place of brass or wrought iron, and also by using yellow or zinc brass in unimportant parts instead of the more expensive red or tin brass. It is well worth the time necessary to go through the stock of brass patterns, and decide which can be made of a metal 3 cents a pound cheaper, and which will answer every purpose.

Frequent examinations of the scrap pile will suggest a use for otherwise scrap material, raising its value from ½ to 2 cents a pound. Even coupling links discarded on account of the M. C. B. coupler have been economically used for the ends of American continuous drawbar rods.

The manufacture of repair parts of air-brake apparatus, etc., when equipped with turret lathes and the proper tools for rapid multiplication, is productive of enormous savings compared with the cost of installation of such machines, and if the road be a large one, the more favorable the results. In fact, there is hardly a process where savings cannot be made if properly investigated, and this without making any cut in wages.

Meetings of the master mechanics, also of the foremen, to consider questions of interest and economy in connection with their work, if attended in the proper spirit, are productive of lasting results, the good practices of one shop being made the standard for all. Besides, these meetings tend to excite an interest in the work, and committees appointed to consider and report on subjects will often introduce valuable suggestions. This has the double advantage that the men will take more interest in making a success of such suggestion as may be adopted, on account of its originating with them. In fact, co-operation in all branches cannot be too strongly advocated, and conferences and meetings are the very best way to produce this spirit of co-operation.

The question of renewals of equipment, and especially of the power, is an extremely important one. Nowadays renewals are mostly made in order to obtain the advantages of more powerful engines or larger cars, without waiting until the older equipment is worn out. If repairs are kept up an engine will be fit for service 25 or 30 years, but engines of that age are generally worthless except for branch service, as they will not pull an economical load. Freight cars that are always loaded to their full capacity, such as coal and ore cars, are mostly so small if 20 years of age, that it is questionable if it pays to maintain them. In many cases, however, an expenditure of $40 or $50 will permit the strengthening and enlarging of such cars so that they will be useful for service. Good judgment is necessary, however, in deciding what is the best action to take, as at times new equipment can be purchased which will give, for a certain expenditure, as great a total capacity as the increase which would be obtained by the reinforcement of the old cars, and have the advantages of modern design, and the capacity of satisfying more shippers, with whom "a car is a car," in many instances.

Renewal charges, if thrown in the repair account, should at least be itemized separately, otherwise comparisons of cost will be valueless. Many roads carry an "equipment renewal fund" which is credited with the cost of a new car or engine upon the destruction of scrapping of the old one, the same amount being charged against the "repair account," and while this distributes more evenly the cost, yet it is important to be able to distinguish between *bona fide* repairs and new equipment.

Locomotive supplies, while dealing with articles of generally small value, require supervision to keep them within moderate bounds. Some roads allow the men all the tools and supplies they want without question; others take and give receipts for the delivery and return of tools, and maintain inspectors who check up the same and see that only the tools officially allowed are carried.

Thus it is by watching the small items that considerable reduction in cost of operation may be accomplished, and this reduction in cost of operation may be accomplished, and this also draws the attention of subordinate officials to the necessity for close investigation of details. Of course, all this requires statements and clerical work, and this can be, and often is overdone, but it is impossible to properly keep watch over the many and varied phases of cost and production without a proper system of statements, and the more frequently these are prepared the more rapidly can changes be made to conform to the variation in the traffic. This suggests the importance of promptly making and transmitting such reports as give an index to the traffic conditions and costs of operation. Private manufacturing establish-

ments have prepared each day a sheet showing the total labor charges of the previous day, and while this would be practically prohibitive on a large road, there is no particular obstacle in the way of the master mechanic of the shop obtaining such daily statement of his home forces. This permits quick and intelligent action, and is well worth the labor of preparation.

In presenting these suggestions on economy of locomotive service, it is felt that much more might have been included, and that the various divisions touched could have been expanded and enlarged, but it was the intention merely to offer suggestions as to the possibility of further economies and to give an outline of the different methods which might be pursued with advantage to the operating department of a railroad.

Frames, Cylinders and Saddles—Pennsylvania Class E-2 Locomotives.

In articles previously published we have traced the development of the Pennsylvania Class E-2 passenger locomotives from the time that the first experimental Atlantic type engine was built and called Class E-1. The several articles appear in the *Railroad Gazette*, July 7, 1899, July 20 and Sept. 14, 1900, and June 14, 1901. The descriptions show that the first engine, Class E-1, had the cab far ahead on the boiler and that the engineer and firemen were thus separated. Later, to keep the men together, the necessary changes were made and the cab was put at the back end of the boiler and the further development of Class E-2 began. In the course of this work some of the vital factors have undergone material changes, among which are the working steam pressure and the total heating surface. The weight of the engine has also changed somewhat, in proportion to other differences, and we have therefore not previously published the weight apportionment. These points are all covered in the general description which we now give and the description in detail which is here given is of the frames, cylinders, and saddles with their fastenings. The cylinders are cast separately from the saddle and the frames, as shown in the accompanying illustrations, give a good demonstration of some of the things that may be done with cast steel.

There are now 23 of these engines in service and their work is very satisfactory, their performance on trains leaving Jersey City and Philadelphia, and also on the seashore runs, being particularly good. The engines are distributed as follows: Pennsylvania Railroad Division 13, United Railroads of New Jersey 8, West Jersey & Seashore Railroad 2. In addition to these, 24 more are being built, 19 of which will go on the Pennsylvania Railroad Division and five on the United Railroads of New Jersey Division.

From the illustrations it may be seen that the frame becomes a broad slab where the saddle and cylinders are bolted together and that an opening 7 in. in diam. through the steel slab gives passage for the exhaust. The dimensions for the various sections of the frame are given in the illustration and it is also apparent that while the bar frame idea is generally carried out in the design the top and bottom rails are again merged into a single slab at the back end, to the rear of the pedestal jaws for the trailing axle. The front frames are fastened to the main frames by five 1⅛-in. bolts in the top rail and four bolts of the same size in the bottom rail, keys being used in the frames to guard against shearing of the bolts. The cylinders are fastened with 19 1⅛-in. bolts which pass through the flanges of the cylinder and saddle. The keys of the upper and lower frame rail are riveted over after driving, and the cylinder and saddle keys are drilled and bolted. Advantage offered by cast steel has been recognized in widening the frames at the pedestal jaws to 5½ in. and thus using 3 in. depth in the rail above the pedestal jaws.

Reference to the illustrations of cylinders and saddle may suggest that these castings can be more easily made than half-saddle castings in which the cylinder is an integral part of the casting. The cylinders resemble somewhat those made by the Manchester Locomotive Works 30 years ago insofar as having an outside passage for steam from the saddle to the steam chest may offer resemblance. The method of connecting is different, however, in the E-2 cylinders, the steam passing from the side opening A of the saddle through a Y connection into the cylinder openings B B. Passages from these openings lead to side admission ports.

There being no upper and lower frame rail to consider at the cylinder attachment, there is room for a large exhaust passage and this has been utilized without interfering with the opening D, which gives a liberal communication between the steam inlets B B. Thus the exhaust passes down and out through the opening C of the cylinder and through the 7-in. opening in the frame, into the saddle. The drawings show that while liberal steam passages and port dimensions have been used there is a uniformity of metal thickness in the walls of the cylinders that indicates very careful design, and promises freedom from undue strains in unequal masses of metal in expansion. The saddle casting being made in one piece requires but one steam inlet 7 in. in diam., as shown at E, leading into a cross cavity, the outlines of which are shown by the dotted lines in the plan view, and leading finally to the openings A. The exhaust passages F register with the 7-in. opening in the slab section of the frame and turning forward unite at a point 6 in. below the top of the saddle casting and discharge through the common opening G, 5¼ in. in diam.

The general description follows:

General Description.

No. of pairs of driving wheels	2
Diam. of driving wheels	80 in.
Size of driving axle journals	9½ in. diam. x 13 in. long
Length of driving wheel base	7 ft. 5 in.
Total wheel base of engine	30 ft. 9½ in.
" " " " " and tender	60 ft. 1 13/16 in.
No. of wheels in engine truck	4
Diam. of wheels in engine truck	36 in.
Size of engine truck axle journals	5½ x 10 in.
Spread of cylinders	85½ in.
Size of cylinders	20½ x 26 in.
Steam ports	1½ x 20 in.
Exhaust ports	3 x 20 in.
Travel of valve	7 in.
Lap of valve	1½ in.
Type of boiler	Belpaire, wide fire-box
Min. internal diam. boiler	65 in.
Number of tubes	315
Outside diam. of tubes	2 in.
Length of tubes between tube sheets	180 in.
Fire area through tubes	5.26 sq. ft.
Size of fire-box, inside	72 x 111 in.
Fire grate area	55.5 sq. ft.
Ext. heating surface of tubes	2,474 sq. ft.
Heating surface of fire-box	166 sq. ft.
Total heating surface of boiler	2,640 sq. ft.
Steam pressure per square inch	205 lbs.
Number of wheels under tender	8
Diam. of wheels under tender	36 in.
Size of tender truck axle journals	5½ x 10 in.
Weight of engine, empty	157,033 lbs.
" on truck in working order	36,650 lbs.
" " first pair of drivers	53,800 lbs.
" " second pair of drivers	55,233 lbs.
" " trailing wheels	30,917 lbs.
Diameter of trailing wheels	50 in.
Size of trailing axle journal	7 x 11¾ in.
Weight of engine in working order	176,600 lbs.
Ratio of heating surface to grate surface	47.56
Ratio of external flue heating surface to fire-box heating surface	14.9
Tractive power per lb. of M. E. pressure	136.6
Tractive power with M. E. pressure equal to ⅘ of boiler pressure	22,400

Frames, Cylinders and Saddles—Pennsylvania Class E-2 Locomotives.

Iowa Railroad Commissioners' Report.

The annual report of the Iowa State Railroad Commissioners has been filed with the Governor. The statistics for the year ending June 30, 1901, show:

Mileage	9,353.90
Passengers killed	7
Employees killed	65
Others killed	151
Passengers injured	104

Employees injured	636
Others injured	142

The report repeats the recommendations of the report of 1899 that laws be passed by the coming Legislature compelling underground and overhead farm and wagon crossings wherever possible. Nearly all of the rolling stock in Iowa has been equipped with automatic couplers and brakes. The Commissioners have inspected and approved 20 interlockings during the year. The board makes special reference to the consolidation of railroads within the State. "The absorption of the smaller lines will be, on account of the safeguards provided by the railroad laws of the State, beneficial rather than otherwise to the people of the State. It has had the effect of not only placing the weaker lines in a higher class, thereby reducing the maximum freight rates prescribed by this board, but also of making a continuous mileage rate in case of shipments that previous to this absorption had to bear the burden of two or more short distance or local tariffs."

The Commissioners call attention to the increasing traffic of the electric lines of the State. Many interurban electric lines are now in process of construction, which are designed to carry freight as well as passengers. It is suggested that the Legislature take some action toward placing these roads under State control.

The Creeping of Rails.

The subject of the creeping of rails and the relation existing between the action of the locomotive and the movement of rails was reported on at the Paris session of the International Railroad Congress, by Baron Joseph Engerth, Engineer of the Austro-Hungarian State Railroads. In our issue of Dec. 6, page 836, mention was made of the fact that he attributed the creeping of rails to the unsymmetrical movement of locomotives, and Mr. Herdner's contribution to this special part of the discussion was printed by us then. Below appears an abstract, very much condensed, of the discussion of this report in the General Session of the Congress.

Baron Engerth (Reporter).—The creeping of rails (leaving out of consideration displacement due to variations of temperature, which, however, cannot be considered to be a negligible amount), makes itself manifest under two distinct forms:

1. Both rails advance at the same rate; this may be called "parallel" creeping.

2. One of the rails advances at a quicker rate than the other; this may be called "unequal" creeping.

In all the papers published on this subject, the remarkable fact is noted that the left hand line of the rails generally advances more than the right hand one, even on straights. This peculiarity has been explained by the statement that the ends of the sleepers nearest the slope of the bank are not as firmly supported. The observations mentioned were made on double track railroads on which the trains run on the left hand track. On the Austro-Hungarian State Railway, however, the left hand rails also show a considerable advance, although the trains run on the right hand track.

This apparent contradiction has led us to investigate the stresses to which the superstructure is subjected under the action of a moving locomotive. In the course of these investigations it was observed that most of the railroads which observed a left hand advance used locomotives with the right hand crank in advance of the left hand one. Besides on railways where the right hand rail advanced there were a large number of locomotives with the left hand crank in advance of the right hand one. The investigations into the causes of these phenomena, which are of special interest, particularly on straights, have led us to the belief that sideway oscillation of the locomotives is the cause of the observed difference of creeping of the two rails; this oscillation acts unsymmetrically, according as the crank on the one or on the other side of the locomotive is in advance. When the crank on the right hand side is in advance, the left hand line of rails creeps most; moreover, if the left hand crank is in advance, the right hand line of rails is most affected. This assumption is confirmed by the observation that the tires of the driving wheels and of the leading wheels become most worn on that side which is opposite to the crank which is in advance of the other.

In order to explain this irregular wear, which has been observed by celebrated engineers and by the managements which we have consulted, we have investigated the disturbing movements of the locomotive from this point of view. This investigation has convinced us that the causes of this sideway oscillation are not to be sought for in the actions resulting from masses having a horizontal movement, but in the actions of the steam. This conclusion has been confirmed by the fact that no such oscillation is observed when a locomotive with closed regulator runs down a falling gradient, whereas a very appreciable sideway oscillation is produced when a locomotive with open regulator ascends a rising gradient. At the same time it was observed that on falling straights the unequal creeping was hardly appreciable, although the parallel creeping was of considerable importance. On the other hand on rising straights, on which steam is kept turned on, very considerable advance takes place. An indirect confirmation of these observations is afforded by the fact that no unequal creeping takes place on electric railways where the power is applied centrally; this shows that the advance is produced by the unsymmetrical action of the twin mechanisms of the locomotive.

We have, moreover, tried to prove the correctness of our views on the one-sided action of the locomotive, by direct experiment; the results obtained are given in a table inserted in the report.

Having become convinced that the sideway oscillation is produced by the action of the steam, we have found ourselves compelled to recommend the investigation of the possibility of removing or reducing the counterweights intended to balance the horizontally reciprocating masses; for these counterweights exercise an unfavorable influence on the track, and cannot prevent the sideway movement which is produced by the action of the steam.

Mr. Siegler (French Eastern).—The creeping of rails is at present only a serious inconvenience which can easily be overcome. Maintenance has something to do with it, but the result is chiefly obtained by the methods of construction adopted. Creeping is now counteracted by means which did not exist formerly. Formerly, I have observed very considerable creeping on tracks with double-headed rails, not fished. Now, on tracks with angular fishplates, the creeping is scarcely appreciable. It gives rise to some disadvantages; without considering the advance of the one rail as compared with the other, the fact that the rail creeps is a nuisance, because the gaps at the joints become reduced, and in some cases closed up. So that even when there is no advance, it is desirable to stop the creeping. But I think the question is solved, and there are no longer any serious difficulties in actual practice.

Hence, it is not necessary to go to any considerable expense to modify the locomotives on the track, and as far as the track itself is concerned, creeping is to-day but of very limited interest. But I consider it a well-established fact, as Baron Engerth has shown, that the phenomenon of the creeping of rails shows phenomena illustrating the want of symmetry of the locomotives and that from that standpoint it would be very interesting to continue these studies, and to ask locomotive engineers to examine this subject, which may for them be of serious theoretical importance.

Mr. Siegler.—Here is a proposal [for a conclusion]: "Creeping of rails is now effectively prevented by suitable construction and maintenance of the permanent way, and it does not give rise to any serious difficulties. From the careful investigations which have been made on creeping, it has been found that the forces exercised by the locomotive on the track are not quite symmetrical, and that the advance of one rail over the other may be in part explained by some forces due to the locomotives. This phenomenon, though not giving rise to serious consequences presents features of theoretic interest to engineers who are engaged in the construction of locomotives." Baron Engerth proposes that it should be decided that the question should be investigated for the next Congress, by locomotive engineers. It seems to me that the above proposal will be sufficient to induce them to study it.

Mr. Herdner.—Gentlemen, I should like to answer, in a few words, the remarks made by Baron Engerth on the subject of counterweights. This subject has been studied everywhere and the conclusion has not been the same as the one that Baron Engerth has drawn from his observations, that vertical balancing alone has to be attained in locomotives. At one time this was the accepted view, chiefly on the faith of text books, as there are authors who state that such balancing alone has to be attained. After a derailment had occurred, it was found that the leading wheels of certain locomotives had counterweights which were too heavy for the vertical balancing, and hence it was thought necessary to reduce them to what they should be on the vertical balancing theory. Then the following phenomena were produced; when these locomotives ran at a speed of 65 to 70 kilometers (40.4 to 43.5 miles) per hour, such endway oscillation was developed that one could see the coal come out of the tender and distribute itself over the footplate of the locomotive, so that the driver said: "The coal goes into the fire by itself."

I am quite ready to admit that at the speed in question there was a simple relation between the period of oscillation of the drawspring and the time in which the driving wheels made a complete revolution, but it is also true that if the spring had been done away with we should nevertheless have had a series of jerking movements which the passengers would probably have noticed. Hence, we had to give up this vertical balancing, and we then proceeded to supply horizontal balancing, which was not the original balancing, to the locomotives; this balancing was intended to do away with the endway oscillation, but as far as the sideway oscillation is concerned (which did not inconvenience us) it had no more effect than the counterweights of the vertical balancing. By this new balancing we arrived, as far as endway oscillation was concerned, at the same result as before, but with the extra counterweights 40 per cent. less in weight. Our exact object was to adapt the locomotives to the track and to obtain the balancing desired, without producing periodic overstrains to which the permanent way engineers might object. We have thus satisfied their desires as far as possible, and I do not think that we can go any further.

I therefore conclude that we should not here touch on the question of counterweights. Their position and weight must satisfy certain conditions, with which, I think, questions as to the unequal creeping of rails should not be mixed up.

Mr. Cotterill, Egyptian State Railways.—It appears that the Congress is about to decide:

1. That the creep of rails is accentuated principally where the rail joints are weak, and that it does not affect in any important degree the permanent way of to-day.

2. That unequal creep is caused by lack of balance in the moving parts of the locomotives, and that an engine with its right hand crank leading will cause the left hand rail to creep ahead of the right rail and vice versa.

I cannot concur with these conclusions as they do not agree with our experience in Egypt. We have found that loose ballast and faulty attachments between rail and sleeper lead more than anything else to creep. Where we have improved our line in these respects we have mastered the creep. Unfortunately we have long lengths of second class lines where the creep still causes us serious inconvenience.

Throughout Egypt the right hand rail creeps ahead of the left hand rail. On page 54 of the report* this is ascribed to the majority of our engines having the left hand crank leading. We have engines of many types and quite half of them have their right hand crank leading, so our creep cannot be quoted as a case in support of the theory given in the report. If we could stop the unequal creep of rails by making a slight alteration to the engine, it would be a most important and economical step, but I fail to see how this is to be effected.

The conclusions proposed by Mr. Siegler were adopted.

TECHNICAL.

Manufacturing and Business.

The Allison Manufacturing Company is shipping by the White Star Line's S. S. "Georgic," some ninety-five freight and passenger cars for Spanish railroads.

Mr. Howard J. Cole, Consulting Civil Engineer, has located his office in the Columbia Building, No. 29 Broadway, New York City.

The Waycott-Andrews Supply Co., St. Louis, Mo., will furnish "Damascus" brake-beams for the following cars recently ordered: Missouri Pacific, 500 cars; Texas & Pacific, 2,500 cars, and Wabash Railroad, 300 cars.

The Standard Railway Equipment Co., maker of "Monarch" pneumatic tools, will move into its new factory at Grand avenue and Sixteenth street, East St. Louis, Ill., Dec. 15. The increasing business of the company had outgrown its old quarters at 210 Vine street, St. Louis, and a shop with larger facilities has for some time been necessary. The new factory is modern in every way. The building is brick and stone, 120 x 100 ft., and is fully equipped with the latest machinery. The company's output will be increased threefold by the change.

Iron and Steel.

H. G. Nichols, formerly Superintendent of the Pencoyd Iron Works, has been placed in charge of the Trenton branch of the American Bridge Co.

It is understood that the Tacony Iron & Metal Co., Philadelphia, whose property was sold at auction recently, will be reorganized and the plant again put in operation within a few months.

Since Congress assembled on Dec. 2 a bill has been introduced in the House of Representatives authorizing a bridge across the Missouri River, at Kansas City, Mo. In the Senate bills have been introduced authorizing a bridge across the Arkansas River near Fort Gibson, Ind. T., and authorizing a railroad bridge across Current River in Arkansas.

The following changes are reported in the Board of Directors of the Empire Steel & Iron Co.: Mark T. Cox, New York, elected in place of W. L. Sims, resigned: Charles H. Zehnder, of New York, late President of the Dickson Manufacturing Co., of Scranton, Pa., in place of E. K. Summerwell, resigned, and David B. Bamble, of Cincinnati, in place of W. E. Scarritt, resigned.

A Big Electric Power Plant on the Susquehanna River. At York Haven, 16 miles southeast of Harrisburg and about 11 miles north of York, Pa., a big electric power transmission plant is being built to use the water of the Susquehanna River taken at a point locally known as the Falls, a short distance above York Haven. The work was begun in June and it is expected that power can be transmitted electrically next fall. This plant will greatly stimulate the industries, and will probably result in locating many new industries, in southeastern Pennsylvania. There will be a race 375 ft. wide and 16 ft. deep from the dam at the head of the Falls to the power house, the length of this race being 3,500 ft. A granite wall is being built from 26 to 38 ft. high, 19 ft. wide at bottom and 16 ft. wide at top, running the full length of the race. A cofferdam was built and within it the foundation of the power house is being laid in an excavation of solid rock. The power house will be 51 ft. x 478 ft., and there will be 40 turbine water-wheels of 600 h.p. each, driving 20 750-k.w. generators; also two turbines of 250 h.p. each to drive exciters. The Stanley Electric Mfg. Co., Pittsfield, Mass., has the contract for generators, and Robert Poole Sons & Co., Baltimore, the contract for turbines.

The Isthmian Canal.

The report of the Isthmian Canal Commission was sent to Congress, Dec. 4. Up to this time we have only the abstracts that have been published in the newspapers. The Commission estimates the cost of the Nicaragua Canal and harbors at $189,864,000; cost of the Panama Canal at $144,233,000; the estimated cost of getting the ownership of the Panama Concession is $109,141,000;

*Vide *Bulletin of the Railroad Congress*, No. 5, May, 1901, p. 1026.

the estimated value of the work done on the Panama Canal is $40,000,000. The sum of the opinion of the Commission is that a canal on the Nicaragua route is more practicable and feasible; but so far we have not seen enough of the argument brought forward to justify any attempt to sum it up.

On December 4 Senator Morgan introduced a bill authorizing the President of the United States to acquire from the States of Costa Rica and Nicaragua the territory necessary for the canal works. Senator Perkins introduced a bill to provide for a perpetual lease by the United States of the right of way across Nicaragua and Costa Rica. This bill appropriates one hundred and twenty millions of dollars to be expended at the rate of twelve millions a year for building the canal. It provides that labor and material originating in the United States, Nicaragua and Costa Rica shall have preference, providing the cost of the work is not thereby increased. It provides for a commission of five citizens of the United States; each commissioner to be paid at the rate of $10,000 a year; these commissioners to take charge of the work of building the canal and to hire the minor employees. It authorizes the President to appoint an engineer at $10,000 a year and an assistant at $8,000 a year, these officers to be under the control of the commission. Three of the commissioners shall be required to be constantly in Nicaragua and Costa Rica, and two at their office in Washington.

The Middletown Car Works.

We have recently spoken of the reorganization of the Middletown Car Works. That concern has in hand an order for steel underframe gondolas, for export, received from an English engineer. The company has a soft iron foundry of 25 tons daily capacity and is doing a considerable trade in architectural and machinery castings, aside from its car work.

International Association for Testing Materials.

The reports of the technical commissions, intended for the Congress held at Budapesth, and also of the scientific and technical communications and lectures, were printed and distributed to all the members of the Congress. The cost of translating and printing the official communications, especially the reports of chairmen of technical commissions of the Association, was met by the Association funds, the cost of the other papers by the funds of the Congress, which received for this purpose considerable assistance from the Hungarian government, as well as from manufacturers and other sympathizers with the work. Every member attending the Congress had the right to obtain copies on taking a Congress Card; but only a small number of members have availed themselves of this right. The Council of the Association intends to prepare a new edition of the publications of the Congress in French and German, and to offer this to those interested at cost price, provided that a sufficient number of members express themselves in writing as ready to subscribe for copies of such edition. Single papers cannot be issued, but it will be possible to obtain the communications in any one of three sections, as below, if the whole work is not desired: (a) Metals; (b) Natural and artificial building stone and their mortars and cements; (c) Other materials of technical use. The exact cost of a copy of such an edition cannot be given till the size of the edition is known, but in any case the price of the whole publication would not exceed 15 or 20 francs.

New Shops of the St. Louis, Iron Mountain & Southern.

The new car and locomotive shops of the St. Louis, Iron Mountain & Southern, now building at Baring Cross, are expected to be completed about April 1 of next year. The buildings will cover 10 acres. The following are the dimensions of the main buildings: Locomotive erecting, boiler and machine shop, 135 x 529 ft.; blacksmith shop, 90 x 221 ft.; power house, 81 ft. x 121 ft.; office, two stories and basement, 50 x 150 ft.; passenger car shop, two stories, 100 x 199 ft.; paint shop, 100 x 199 ft.; planing mill, 80 x 201 ft.; and freight car shop, 70 x 300 ft. Beside these buildings there will be a large paint storage room, lavatories and oil house. There will be two transfer tables, one 60 x 575 ft. and one 70 x 245 ft.

Pittsburgh Filtration Plant.

The Filtration Committee of the Pittsburgh Councils has approved the plans for 60 per cent. of the work to be done on the filtration plant, and took favorable action on the ordinance for letting a contract for not more than $1,500,000. Director of Public Works Dr. J. Guy McCandless is reported as saying that he will be ready to advertise for bids for this work within a week or two.

The June Conventions.

The meeting of the Executive Committees of the Master Car Builders' Association, Master Mechanics' Association, and Supplymen's Association, was held at Buffalo, December 11. It was then decided to hold next year's conventions at the Grand Union Hotel, Saratoga Springs, beginning June 18th.

Estimates for Navy Yards.

Rear Admiral Endicott, Chief of the Bureau of Yards and Docks, has submitted estimates for the maintenance of the navy yards and stations and improvements aggregating $21,526,359. The estimates of the various yards are as follows: Portsmouth, N. H., $1,947,575 (this includes $500,000 for a new floating dry dock); Boston, $1,570,000; naval coal depot, Rhode Island, $200,000; naval station, New London, $51,000; New York, $3,475,000; League Island, $741,300; Washington, $622,000; Norfolk, $1,511,000; Charleston, $1,650,000; Key West, $93,000; Pensacola, $995,800; Algiers, La., $359,000; Mare Island, $888,700; Puget Sound, $1,169,500; San Juan, $2,613,000; Tutuila, $108,000; Cavite, $381,000; Olongapo, $1,443,000; Guam, $12,300. In addition to these items the report asks an appropriation of $1,050,000 to complete the four dry docks at Portsmouth, Boston, League Island and Mare Island.

Some of the details for the Norfolk navy yard follow:

Quay wall for fitting out basin, to continue	$250,000
Storehouse for supplies and accounts	150,000
Rebuilding building No. 28	100,000
Rebuilding building No. 39	25,000
Remodelling building No. 17	25,000
Locomotive crane	5,000
Fittings for ordnance storehouse	35,000
Heating system, additions	5,000
Electric plant, extensions	10,000
Remodelling machine-shop for steam engineering	25,000
Electric capstans for dry-docks	10,000
Electric drainage pump	10,000
Car float and transfer slip	35,000
Building for construction and repair	80,000
Steel storage building	30,000
Coaling plant	75,000
Chain and paint shed	23,000
Plant for storing torpedo boats	200,000

The North River Bridge.

It appears to be true that the North River Suspension Bridge is for the present suspended. There has been some pretty serious negotiation and consideration going on for a number of months, and the promoters of this vast enterprise have had good reason to believe that two or three railroads might be induced to back it; but apparently there is no present prospect that such support can be obtained.

The Life of Cross-Ties.

The American Railway Engineering and Maintenance of Way Association has sent out most elaborate sheets for the compilation of statistics which may aid in ascertaining the life of ties and the utility of preservative treatment. It is a matter of great interest that these returns should be generally complete and accurate, but we fear that the committee will be disappointed in the volume of information received. But at any rate a scientific start will be made.

The London Underground.

On the 9th it was announced unofficially that the Board of Trade arbitrator had decided against the Ganz System for electrifying the Metropolitan and Mettopolitan District underground railroads in London. This unauthorized announcement caused a prompt advance of 14 points in the shares of the District, and 5 points in the shares of the Metropolitan, and there has been a little scandal about the leakage of the information. The following day the announcement was confirmed officially. As we said some weeks ago a contract for machinery has been placed by the District people with the Westinghouse Electric & Manufacturing Company.

THE SCRAP HEAP.

Notes.

The number of men employed in the shops of the Pennsylvania road at Altoona is now 7,992, a larger number than ever before.

The Philadelphia & Reading is to buil dat Philadelphia, for the Young Men's Christian Association, a brick and marble building three stories high, 65 x 30 ft.

At Nogales, Ariz., on Dec. 5, the pay car of the Southern Pacific was seized by United States customs officers, who charged that boxes of cigars found in the car had been smuggled from Mexico.

New York papers say that the large express companies have discontinued issuing franks to public officials, large shippers and other classes of persons who heretofore have been regularly favored with the D.H. privilege.

The newspapers state that the Toledo, St. Louis & Western, and the Cincinnati, Hamilton & Dayton are sending out requests for exchange passes the same as in former years, and the requests are accompanied by the usual offer to reciprocate.

The Railroad Commissioners of Texas, after hearing and investigation, have issued to the railroad companies an order directing them to run their trains according to schedule unless delayed by unavoidable accidents. Trains must not wait at junctions more than 30 minutes. Bulletin boards must be maintained at each station. On these each train must be posted 30 minutes before it is due, and the bulletin must be corrected every half hour until the train arrives.

An officer of the Pennsylvania is reported as saying that monthly commutation tickets between Wilmington and Philadelphia are being manipulated by wholesale and farmed out to casual passengers. The regular excursion rate between Philadelphia and Wilmington is $1.00, and the one way rate 67 cents, but the occasional rider has been getting the use of a season ticket for 60 cents a round trip, while the original purchaser made a profit of from $5 to $8 a month. Within a few days fifteen monthly tickets were taken up by conductors in the hands of persons who failed to identify themselves as the rightful owners.

Traffic Notes.

The Long Island Railroad has laid before the New York State Railroad Commission a complaint alleging that the rates allowed by the government to the road for transporting the mails are unremunerative.

The Government of Mexico having temporarily suspended the import duty on grain, large quantities of wheat and corn are being shipped into that country; and there is such a blockade at El Paso that the Atchison road has been compelled to refuse further shipments.

The members of the Minnesota State Railroad Commission announce that they are going to Washington to confer with the Interstate Commerce Commission as to the best way of preventing detriment to the public interest by the alleged consolidation of the Northern Pacific and Great Northern roads. On the formation of the Northern Securities Company, which was organized to buy and own stocks of these two roads the Governor of Minnesota announced his purpose to prevent the "combine"; and the present action of the commissioners is in furtherance of the governor's proposition.

The presidents of railroads west of Chicago were to have held a meeting in New York on Dec. 5, but nothing appears to have been done, though many presidents were in New York on that day. A number of subordinate officers gathered at the appointed place, but they say that they did not do anything. The reporters cannot decide whether the fiasco was due to a general feeling that rate agreements are worthless, or to a desire to avoid the appearance of a "trust conference" while the Governor of Minnesota is trying to arouse public interest in the alleged oppressive acts of the Northwestern roads.

Rate cutting appears to have been on the increase during the past two or three weeks. Merchandise from the East to Colorado and Utah has been taken by the lines running through New Orleans and Galveston at very low rates, which rates appear to have been met by the direct railroad lines; and the railroads are now cutting rates as against one another. It is said that there is also very sharp competition on packing house products from Omaha and Kansas City to the East. This cutting, also, is said to have been started by the lines to the Gulf of Mexico. The Chicago reporters say that the demoralization of rates has extended to the general field, though they do not give particulars.

Signaling Notes.

Interlocking signals have been put in at the crossing of the Pennsylvania road and the Jamestown, Chautauqua & Lake Erie, near Mayville, N. Y. The machine has 33 levers.

Plans have been approved by the State Commissioner of Railroads for interlocking to be installed at the crossing of the Chicago & North Western and Chicago, Milwaukee & St. Paul railroads at Quinesec, Mich.

Plans have been submitted to the Commissioner of Railroads for the State of Michigan by the Detroit, Lake Orion & Flint Railway Company for interlocking signals to be installed at the crossing of its line and the Grand Trunk Western Railway on Harrison street in the city of Flint.

A drawbridge on the North Eastern Railway, of England, over the river Ouse, at Skelton, is now so interlocked with the signals which govern the approaches to the bridge that when a clear signal has been given to an approaching train the bridge is locked so that only the passage of the train can unlock it. In case of failure of apparatus or other contingency which may make it desirable to unlock the bridge before an expected train reaches it, the lock can be released by a key, which is made in two halves, one half being held by the bridge tender and the other by the agent at the station nearest the bridge.

Railroad in Santo Domingo.

Daniel C. Patterson, of Omaha, Neb., is at Santo Domingo to begin work on a new line between Samana and Seybo around the end of Samana Bay, a total of about 120 miles. The concession was obtained by O. Zetterlund and is considered very valuable.

South American Notes.

Ballasting on the Maipu line in Brazil is reported proceeding at the rate of 3,500 tons a day, including both conchilla or shell work and broken stone.

There has been a serious strike on the Recife-San Francisco line in Brazil, caused by reduction in the time allowed employees for their meals, increase in the hours of work, cancellation of their free passes, and dismissal from the service of the company in case of illness lasting over 30 days. The last proviso was considered particularly objectionable.

The following work is reported on the Buenos Ayres Western: Extension of the Villegas branch 60 km. west of the fifth meridian, to have been opened Dec. 1, with further extension contemplated; extension to run west 196 km. from Lincoln to the fifth meridian, constituting a new branch between the main line and the Villegas-Tordillo line to the north; also an extension south from Trenque Lauquen to Carhue, on the Great Southern, 134 km. These three extensions, aggregating 450 km., will make a total of 1,400 km. operated by the company.

East River Bridge No. 3, New York.

The first caisson for the new East River Suspension Bridge, which will be known as Bridge No. 3, is being built at 151st street and the Harlem River, and will be finished in another month by Contractor J. C. Rodgers. The caisson will be 108 ft. long x 48 ft. wide, and will require 2,000,000 ft. of lumber. When finished it will be towed down the East River to the foot of Washington street, Brooklyn, where the Brooklyn tower will be built.

Legislation for Engineering Works.

Among the large number of bills introduced into the new Congress (about 4,200 being introduced in the first five days of the session) are the following, relating to engineering works, in addition to the several bills providing for an interoceanic canal: In both the Senate and House of Representatives, bills for cables from San Francisco to Hawaii, Guam, the Philippines and the East; in the Senate for a ship canal through Maryland and Virginia to connect the waters of the Chesapeake and Delaware Bays, this canal to be 100 ft. wide at the bottom, 26 ft. deep at low water and to cost in all $10,000,000; in the House of Representatives for a deep waterway from deep water in the Mississippi River to the Gulf of Mexico, via Southwest Pass; in the House, to adopt weights and measures of the metric system as standard weights and measures of the United States, this bill being introduced by the Chairman of the Committee on Weights and Measures and referred to that committee Several bills for reservoirs and other irrigation works in States having arid lands, have been introduced in both houses; a bill to extend the time for building the Chicago, Rock Island & Pacific Railway, through Indian Territory; large numbers of bills providing for river and harbor improvements at various points and for new public buildings have also been introduced.

On Certain Great Guns.

The report of the Joint Army and Navy Board which made the recent tests of guns at Sandy Hook was sent to Congress, Dec. 6, by the Secretary of War. The Board reports against the Gathmann system, saying that a battleship would not be seriously injured by the explosion of a Gathmann shell against its side. The report favors

the new army gun, which, it says, throws a destructive energy hitherto unequaled by any gun made.

Commerce Through the Canals at Sault Ste. Marie—Nov., 1901.

East-Bound.	
Copper, net tons	14,034
Grain, bushels	8,882,472
Flour, barrels	1,042,169
Iron ore, net tons	1,651,465
Lumber, M. ft. B. M.	128,773
Wheat, bushels	13,348,335
General merchandise, net tons	14,029
Passengers, number	1,683
West-Bound.	
Coal, hard, net tons	137,496
Coal, soft, net tons	383,409
Manufactured iron, net tons	38,633
Salt, barrels	47,138
General merchandise, net tons	70,304
Passengers, number	1,451
Total freight, net tons	3,274,201
Vessel passages, number	2,226
Registered tonnage, net tons	2,910,840

The Telford Medal for an American.

Mr. Reginald Pelham Bolton, M. Am. Soc. C. E., Assoc. M. Inst. C. E., has received from the Institution of Civil Engineers the Telford Medal and the Telford Premium for a paper on "The High Office Buildings of New York."

Concerning Isthmian Canals.

A New York daily paper, not famous for its reliability, prints a statement of the recent doings of Mr. Hutin, President of the New Panama Canal Company, which, if true, would go a good way to explain why the Canal Commission decided that the Nicaragua route is the more practical and feasible. We guess that the report of Mr. Hutin's doings is not entirely incorrect.

"Admiral Walker had been corresponding with President Hutin in an endeavor to secure a definite statement as to the price at which the United States could buy that property. This correspondence covers more than seventy pages in that part of the commission report devoted to a consideration of 'rights, concessions, etc.' It threatened to become interminable, and Admiral Walker finally notified M. Hutin that unless the commission received from him by November 5th, a definite price at which the Panama Canal could be bought communication with him would be closed. To this, on November 4, President Hutin replied with a note maintaining that the present value of his canal was $109,000,000, but asking again that the matter be submitted to appraisal. As the appraisement scheme had been advocated by him throughout his correspondence and had been rejected by the commission, and as these were the only figures submitted by him, he was notified that they would be accepted as his answer to the commission's question as to the price of the canal. The Commissioners at the final meeting were surprised to have M. Hutin protest against the construction placed upon his letter. He asserted that he did not intend $109,000,000 to be taken as his final price. When confronted with Admiral Walker's letter, to which his note naming these figures was a response, he threatened to go over the heads of the Commissioners to Secretary Hay and President Roosevelt and make complaint against what he termed their 'summary action.' Mr. Morrison then abandoned his intention of putting in a report favoring the Panama Canal, and all signed the report recommending the Nicaragua route. M. Hutin was allowed to deposit his paper, which, besides complaining of the commission's treatment of him, appeals anew for the appointment of appraisers. This paper was not sent to Congress by the President with the commission's report, but has been placed in the hands of Senator Morgan, and will be discussed in the report which he will submit on his Nicaraguan Canal bill."

LOCOMOTIVE BUILDING.

The Northern Pacific is having five locomotives built at Schenectady.

The Norfolk & Western is having four locomotives built at the Baldwin Works.

The Illinois Central has ordered 34 engines from the Rogers Locomotive Works.

The Central of New Jersey has ordered 60 engines from the American Locomotive Co.

The Louisville & Nashville has ordered 15 locomotives from the Rogers Locomotive Works.

The Chilian State Railways have ordered the eight engines, for which they were reported asking bids Oct. 4, from the Baldwin Works.

The Chicago & North Western has placed orders with the American Locomotive Co. for 20 switchers, 16 freight and four passenger locomotives for 1902 delivery.

The Chicago Great Western order, placed with the American Locomotive Co., and reported in our issue of Nov. 22, calls for the following: Five six-wheel switching engines; they will weigh 130,000 lbs. and have 19 x 26-in. cylinders with 51-in. driving wheels, extended wagon top boilers with a working steam pressure of 200 lbs., fire-box 9 ft. long 3 ft. 6 in. wide, tender capacity for 4,000 gals. of water and five tons of coal. Three passenger locomotives, to weigh 180,000 lbs. and 130,000 lbs. on the driving wheels and have 21 x 26-in. cylinders and 73-in. driving wheels with wide fire-box, and a working steam pressure of 225 lbs., fire-box 8 ft. long and 6 ft. wide, tender capacity 6,000 gals. of water and 12 tons of coal. And 12 cross compound freight engines, the same as previously ordered from the American Locomotive Co., all for March, 1902, delivery. The specifications for all include Westinghouse brakes, Sargent brake-shoes, Tower couplers, Jerome piston rod packings, Leach sanding devices, Michigan sight-feed lubricators, Latrobe springs, Crosby steam gages, Consolidated steam heat equipment, Midvale tires and driving wheels.

CAR BUILDING.

The Missouri Pacific has ordered 500 coal cars from the American Car & Foundry Co.

The Southern Pacific has ordered 500 tank cars from the American Car & Foundry Co.

The Toledo, Peoria & Western is reported having two coaches built by the Pullman Co.

The Denver & Rio Grande has ordered 20 coaches from the American Car & Foundry Co.

The Indiana, Illinois & Iowa has ordered six cabooses from the American Car & Foundry Co.

The Chicago Great Western has ordered 20 eight-wheel cabooses from the American Car & Foundry Co.

The New York, Ontario & Western has ordered seven coaches from the American Car & Foundry Co.

The New York, Chicago & St. Louis has ordered 1,000 box cars from the American Car & Foundry Co.

The El Paso & Northeastern has ordered 10 eight-wheel cabooses from the American Car & Foundry Co.

The Richmond, Fredericksburg & Potomac has ordered three passenger cars from the American Car & Foundry Co.

The American Car & Foundry Co. is building a private car for George J. Gould, and nine logging cars for individual concerns.

The Central of New Jersey has ordered 1,000 box cars and 20 coaches from the American Car & Foundry Co.; also 30 coaches, five baggage and five combination cars from the Harlan & Hollingsworth Co.

The Illinois Car & Equipment Co. has received an order for 50 tank cars from a private concern in the Texas oil fields. This is in addition to the order for 50 cars noted in our issue of Dec. 6.

The Delaware, Lackawanna & Western has ordered 1,000 steel coal cars of 80,000 lbs. capacity from the Pressed Steel Car Co., instead of from the American Car & Foundry Co., as reported last week.

The Pennsylvania has ordered 500 gondolas of 100,000 lbs. capacity and steel underframes from the Illinois Car & Equipment Co., in addition to the 775 box cars of the same capacity, ordered and reported in our issue of Dec. 6.

The Rodger Ballast Car Co. has sold to the Seaboard Air Line 40 standard 34-ft. 40-ton ballast cars and one standard distributing car, equipped with air and M. C. B. couplers. This equipment has been in use upon the road ballasting during the past season.

The Atchison, Topeka & Santa Fe is reported to have ordered 300 flat cars from the American Car & Foundry Co., and the question of new freight car equipment for delivery in 1902 is now being discussed. It is said that from 3,000 to 5,000 cars will be ordered.

The St. Louis & Memphis has placed an order with F. M. Hicks, of the Hicks Locomotive & Car Works, Chicago, for four coaches, two of which are to be passenger, and two combination mail, passenger and baggage. The passenger coaches are to have oak interior finish, crimson plush upholstered seats with oak ends, double chandelier lamps, Miller platforms, Janney couplers and Westinghouse quick-action air-brakes. The two combination coaches are to be of the same general type and finish as the coaches.

BRIDGE BUILDING.

Altoona, Pa.—The committee appointed to get plans and estimates for a bridge or subway across the railroad tracks at Eleventh street, has reported that the King Bridge Co. estimated the cost of the subway at $245,000. The estimate for a bridge is $108,000. It is understood that the committee will urge the building of a bridge. Harvey Linton is City Engineer.

Americus, Ga.—Unless the Seaboard Air Line begins work on rebuilding the Barlow street bridge over its tracks within 10 days, the City Council, according to local report, will do the work at the expense of the company.

Anadarko, Okla. T.—The County Commissioners have decided to build a large iron bridge across the Washita River.

Ashland, Me.—The Fish River R. R. (Bangor & Aroostook) has let contracts to the Pennsylvania Steel Co. for the four bridges, one 707 ft. long over Aroostook River, two over Fish River 270 ft. and 180 ft., and a 95-ft. bridge over Wallagrass stream at a total of $150,000. The company has put in the foundations.

Bay City, Mich.—City Engineer Thompson has made plans for a new drawbridge to be built across Kawkawlin River at Henry street, and the Town Board will probably let the contract in the near future.

Belton, Texas.—J. M. Carter, 294 Exposition avenue, Dallas, Texas, is reported interested in the electric railroad company, which will build a 250-ft. bridge over Leon River.

Boise, Idaho.—See Other Structures.

Buffalo, N. Y.—Bids will be received at the Department of Public Works until 11 a.m., Dec. 24, for building the superstructure of a bascule bridge on South Michigan street over the City Ship Canal, in accordance with plans and specifications on file in the office of the Bureau of Engineering. R. G. Parsons, Secretary of the Board.

The Board of Aldermen is considering the application of Sidney Shepard & Co. to build a bridge across Tennessee street connecting their factory buildings; also the application of J. N. Adam & Co., who want to build a similar bridge across Washington street.

Bids are wanted, Dec. 20, by the Grade Crossing Commission, for the superstructure of a viaduct over the railroads in Louisiana street. Edward B. Guthrie, Chief Engineer. The estimated cost is $250,000.

Chester, Pa.—The Pennsylvania R. R. will need five bridges in connection with its work to raise its railroad tracks through this city.

Cincinnati, Ohio.—Separate sealed proposals will be received at the office of the Board of Public Service until noon of Dec. 30, for the substructure and approaches, and the superstructure of the St. Clair bridge from Euclid avenue to Eden avenue. The plans are with the Engineer of the Board. The superstructure will consist of three steel deck spans of 75 ft. each, and approach spans, making a total length of 348 ft. The roadway will be 17 ft. wide and there will be two 6½-ft. sidewalks, making the total width 30 ft. Robert Allison, President of the Board.

Cleveland, Ohio.—City Engineer Carter is reported making plans and estimates for a viaduct from the foot of Lorain street, on the West Side, to Huron street on the east side of the river. It is said that such a viaduct would cost over a million dollars.

Concord, N. H.—The Boston & Maine and the City Engineer are considering changes to be made in the railroad bridge over Webster street.

Covington, Ky.—It is proposed to extend Gilbert avenue by building a viaduct across Eggleston avenue to Broadway.

Danville, Ill.—Contract for the stone arch bridge for the Big Four over the North Branch of Vermillion River, to cost over $100,000 and mentioned last week, is let to Yawger & Battefeld, of Indianapolis.

Easton, Pa.—The viewers appointed by the Northampton County Court (See Glendon,, Pa., Nov. 22, p. 814) to consider a site for a new bridge over Lehigh River at Glendon, have reported in favor of a highway bridge to be about 600 ft. long.

East St. Louis, Ill.—The State Railroad & Warehouse Commission has decided that the Chicago, Peoria & St. Louis Ry. shall put in an overhead crossing where it crosses the Chicago & Alton at Bridge Junction, East St. Louis. The bridge will be 22 ft. high.

Elyria, Ohio.—The Councils are considering building a new bridge at Washington street and have engaged an engineer to prepare plans.

Fort Dodge, Iowa.—The King Bridge Co., of Cleveland, Ohio, has the contract for building the Chicago Great Western bridge across the Des Moines River at Fort Dodge at about $500,000. The total length of the structure will be 2,585 ft.

Fort Worth, Texas.—Local report says that improvements are to be made at the Fort Worth stock yards, which include three viaducts. One viaduct will be built north of the Fort Worth Packing House and across the St. Louis Southwestern tracks. The other two viaducts will be built some distance north, crossing the Gulf, Colorado & Santa Fe, the Chicago, Rock Island & Texas, and the Fort Worth & Denver City.

Franklin (Venango County), Pa.—The Pennsylvania R. R. will build a connecting line between Stoneboro and Oil City, and bridge the Allegheny River near Franklin.

Grand Island, Neb.—The Board of Supervisors of Hall County will receive bids until noon of Jan. 1, for all bridges needed in the county during the year 1902.

Holland, Mich.—The Pere Marquette R. R. will build a double track bridge over the electric railroad at the main line crossing between Holland and Waverly.

Houghton, Mich.—At a meeting of the Portage Township Board, held in Houghton last week, the question of building a new bridge over Sturgeon River, near Otter Lake, was considered. It is stated that bids will soon be wanted.

Kansas City, Mo.—All the railroads interested in the Allen avenue viaduct have agreed to the ordinance passed in October. The roads are the Atchison, Topeka & Santa Fe; Kansas City, Fort Scott & Memphis and the Chicago, Burlington & Quincy; also the Metropolitan Street Ry., and the Kansas City Stock Yards Co. It is possible that bids will soon be wanted on this bridge, which will be designed after Cooper's 1896 highway bridge specifications. Address the Metropolitan Street Ry. (Oct. 18, p. 272.)

Lansing, Mich.—Plans and specifications have been approved for the Washington street bridge. (Nov. 8, p. 780.)

Mainville, Pa.—The Philadelphia & Reading has decided to replace the wooden trestle over the ravine in the vicinity of Mainville with a steel viaduct. It will be about 450 ft. long and about 100 ft. high.

Marcus Hook, Pa.—The Pennsylvania R. R. is reported making plans for a subway at the crossing of Glenwood avenue and the matter will soon be brought before the Borough Council. The company will also abolish the grade crossing at Trainer Station by building a subway at that place.

Milwaukee, Wis.—Local report says that the bids for the Broadway bridge will probably be rejected and new bids advertised for.

Montgomery, Pa.—Viewers have reported favorably upon the project for a bridge over the river at Montgomery which will be about 940 ft. long.

Morgantown, W. Va.—The County Court has appropriated $12,000 to build a steel bridge over Crooked Run.

New Castle, Pa.—The December Grand Jury has returned presentments to the County Court providing for an expenditure of nearly $250,000 for new bridges in the city of New Castle. The largest structure recommended is a viaduct over the Neshannock River from Croton to Highland Avenue Hill. The length will be 950 ft.

The Jury has also recommended a viaduct over the Shenango River, at Mahoning avenue extension, and also over the tracks of four railroads. The railroads will pay part of the cost of the latter bridge, which is estimated to cost about $75,000.

New York, N. Y.—The bids received, Dec. 5, by the Commissioner of Bridges for the Vernon avenue bridge, over Newtown Creek, which was illustrated Nov. 29, p. 822, were: United Engineering & Contracting Co., $547,046.75; Bernard Rolf, $614,802.50; King Bridge Co., $631,198; Liebmann & Gahagan, $636,191.50. The award was made to the lowest bidder.

Omaha, Neb.—D. M. Haverly, County Clerk, will receive bids until noon of Dec. 26, for all material, etc., for all bridges needed during the year 1902.

Peoria, Ill.—A large steel viaduct is proposed for the crossing of Prospect avenue over the tracks of the Chicago, Rock Island & Pacific and the Peoria Ry. in the village of Peoria Heights.

Philadelphia, Pa.—Mr. Webster of the Survey Bureau, has sent to Councils a list of 30 bridges which should be built at the earliest possible date, and from those submitted Councils are to select the ones which are to be built during the coming year. The total cost of the 30 bridges is estimated at nearly $2,000,000, and the list is as follows:

Thirty-third street, over the Philadelphia & Reading, to complete, $110,000; Passyunk avenue, over the Schuylkill, to continue, $116,000; to complete the same bridge, $440,000; Fifty-second street, over West Chester & Philadelphia Railroad, $36,000; Hunting Park avenue, over the Philadelphia & Reading, city's share, $25,000; Seventeenth street, over Reading Railway, $75,000; Large street, under the Reading Railway, city's share, $18,000; Erie avenue, under the Reading Railway, $64,000; Graver's lane, over the Reading Railway, $12,000; Frankford avenue, over Poquessing creek, $30,000; Allegheny avenue, under the Connecting Railroad, city's share, $36,000; Walnut lane, over Wissahickon creek, $160,000; Sedgley avenue, over the Reading Railway, $44,000; Stokley street, over the same, $35,000; Glenwood avenue, over the same, $30,000; Wyoming avenue, over Frankford creek, $115,000; Armat street, under the Reading Railway, $70,000; Montgomery avenue, over the Connecting Railroad, $60,000; Fifty-eighth street, over the West Chester & Philadelphia Railroad, $38,000; Front street, over the Connecting Railroad, city's share, $30,000; Sixty-fifth street, over the Philadelphia, Wilmington & Baltimore, $33,000; D street, over Connecting Railroad, city's share, $20,000; Sixtieth street, over the Philadelphia, Wilmington & Baltimore, $47,000; Centre street, under the Reading Railway, $31,000;

Twelfth street, under the Connecting Railroad, $50,000; Woodbine avenue, north of Haverford avenue, $55,000; upper deck of Falls bridge, $300,000; School lane, over the Reading Railway, $36,000; Collom street, under the Reading Railway, $8,000; Bellfield avenue, under the Reading Railway, $50,000.

An ordinance is before the Councils providing for a bridge on the line of the Philadelphia & Reading at Sedgely avenue.

PORT HURON, MICH.—The Common Council has taken preliminary steps for building a bridge across Black River at Lincoln avenue.

RICHMOND, IND.—The Pennsylvania Co. will build a new bridge across Whitewater River at a cost of about $500,000.

ROSWELL, N. MEX.—The Board of Trustees are considering building a bridge over North Spring River on Pennsylvania avenue; also a bridge over Hondo River, on Kentucky avenue.

SAGINAW, MICH.—Plans and estimates have been ordered by the Common Council for moving the present bridge over Geisser avenue to Center street, and building new approaches; also plans and estimates for a new bridge at Sixth street.

SANDUSKY, OHIO.—The Lake Shore Electric Ry. for some time has been trying to get permission to run on the Huron street bridge, which is owned by the county. This permission is denied and the railroad company will be obliged to build its own structure.

SAN FRANCISCO, CAL.—The American Can Co. has petitioned the city authorities for permission to build a steel bridge over Seventh street west of Townsend to connect their factory buildings.

STRASBURG, VA.—The Board of County Supervisors has appropriated $4,000 for a steel bridge over Shenandoah River near Strasburg.

TREESBANK, MAN.—The Canadian Pacific has decided to build a steel viaduct in place of the present wooden structure 3,000 ft. long across the Souris Valley at Treesbank. A steel viaduct will be built to replace the temporary bridge across the Souris River.

WASHINGTON, D. C.—See Washington Terminal in Railroad Construction column.

WILKESBARRE, PA.—There is an ordinance before the Select Council which appropriates $40,000 for a bridge over the railroads tracks in North Wilkesbarre connecting Pearl and Butler streets. We are told that the ordinance will have to be put to vote before the work can be contracted for.

Other Structures.

ATLANTA, GA.—A bill to require the rebuilding of a union station on the State of Georgia property in Atlanta, passed the Georgia House of Representatives, on Dec. 5. A Commission of nine, headed by the Governor, is to be appointed to receive bids and pass upon plans for the station. About $1,000,000 is available for this work on Jan. 1, 1903, but the Commission is empowered to proceed with the work as soon as the bill passes the Senate.

BOISE CITY, IDAHO.—Bids are being asked by the Boise Payette River Power Co. for its plant on the Payette River. The work consists of one-half mile of canal, one-fourth mile of flume, masonry head works, waste gates, culverts, bridges and power house of concrete. Plans and specifications may be had at the office of the company in Boise City. A. J. Wiley is Chief Engineer.

BUFFALO, N. Y.—The various railroads entering Buffalo and the city officers are again considering the question of building a union passenger terminal in Buffalo.

GRAND FORKS, B. C.—The Victoria, Vancouver & Eastern will build a new passenger station in Grand Forks at a cost of $15,000.

GREENVILLE, PA.—Regarding the report that a large appropriation has been made for the new shops of the Bessemer & Lake Erie at Greenville, we are told that the company is about to spend a sum not to exceed $100,000 at that point for increased shop facilities.

GREENWOOD, S. C.—The State Railroad Commissioners have ordered the Southern Ry. and the Charleston & Western Carolina to build a new passenger depot in the city of Greenwood, where the two railroads cross.

GUNTERSVILLE, ALA.—The Alabama Railroad Commission has ordered the Nashville, Chattanooga & St. Louis to build a new passenger station in Guntersville. It will be 25 ft. wide and 100 ft. long; and there will also be a freight warehouse built.

LEBANON, PA.—The West End Rolling Mill Co. has decided to build a new office building and to add three furnaces to the rolling mill and chain department. The contract for the boilers is let to the Lebanon Boiler Works. C. Shenk has recently been elected President, succeeding J. Henry Miller, resigned.

MCKEESPORT, PA.—The new furnace of the National Tube Co., building at Wheeling, W. Va., will be finished early in the spring, and will have a capacity of 600 tons per day. There is no truth in the report that additional furnaces will be built at McKeesport.

MCKEES ROCKS, PA.—The Fort Pitt Malleable & Gray Iron Co., of Pittsburgh, will build a new foundry here.

MOBILE, ALA.—The Mobile, Jackson & Kansas City has let contracts for a new coaling plant to Merrill & Suck, of Mobile. The contract for the machine shop is let to E. E. Ward. The contract for the pier on the east side of Choctaw Point will be awarded Dec. 20.

NAVARRE, OHIO.—The Wheeling & Lake Erie is having plans made for a large machine shop and repair house at Navarre, where the Columbia and Canton shops are to be consolidated.

NEW ALBANY, IND.—The Ohio Falls Iron Co., which recently bought the old rolling mill at New Albany, will install a puddling mill, bar mill and a mill to roll light rails. The company is in the market for machinery, both for an electric lighting plant and for the mill.

NEW ORLEANS, LA.—New Orleans despatches state that the courts have decided against the Illinois Central R. R. in the mandamus proceedings to compel the Levee Board to allow it to extend the Stuyvesant docks at New Orleans.

PITTSBURGH, PA.—The Pittsburgh, Carnegie & Western (Wabash) will build about 16 station buildings between Pittsburgh and the Ohio River. A large passenger and freight station will be built at the south end of the tunnel which is to penetrate Mount Washington Hill, and there will be another station in Chartiers Valley.

The Follansbee Bros. Co., large dealers in black and corrugated sheet steel, are reported preparing to build a plant of their own. It is said the company proposes to put up an eight-mill plant in the Pittsburgh district.

READVILLE, MASS.—The New York, New Haven & Hartford is reported about to contract for the electric power plant for its new shops in Readville.

ST. PAUL, MINN.—The Great Northern has recently let the contracts for the foundations for five buildings for its new shops in St. Paul. The plans provide for a large boiler shop, machine shops, forging and blacksmith shop, power house and a store house.

SOUTH BETHLEHEM, PA.—The Board of Directors of the Bethlehem Steel Co., at a meeting held last week, authorized an expenditure of $500,000 to increase the armor making capacity of the plant. The output will be increased from 4,500 tons to 6,000 tons per annum.

TOLEDO, OHIO.—The Craig Ship Building Co. will build new foundry buildings in Toledo.

WASHINGTON, D. C.—A bill has been introduced in the Senate providing for building an Executive Building in Washington on the land south of the Treasury Department, at a cost of about $1,000,000.

The Washington Terminal Co. was recently incorporated to eliminate the grade crossings in the District, and to build terminals for the Baltimore & Ohio and Pennsylvania Railroads. (See Railroad Construction.)

WILMINGTON, DEL.—An officer of the Pennsylvania R. R. has notified the local Board of Trade that the company proposes to build new shops east of Vandever avenue and south of the tracks, and that a general plan has already been prepared.

WORCESTER, MASS.—The Boston & Maine freight house in Worcester was burned on Dec. 7, causing $25,000 damage to the building.

YORK, PA.—Guy Webster, Secretary and Treasurer of the York Bridge Co., tells us that his company expects to build a bridge plant in York at once. The capital stock of the new concern is $30,000. G. W. Dury is President.

YOUNGSTOWN, OHIO.—The Youngstown Steel Casting Co. has bought the plant of the Forsythe Scale Works and will equip it with foundry machinery shortly. In addition to the present buildings, two new ones will be built, 70 x 130 ft., and 50 x 200 ft. E. B. Lawrence, Arthur Eyron and J. R. Long are members of the Board of Directors.

MEETINGS AND ANNOUNCEMENTS.

(For dates of conventions and regular meetings of railroad associations and engineering societies see advertising page xvii.)

St. Louis Railway Club.

The December meeting of the St. Louis Railway Club will be held at the Southern Hotel, on Friday, Dec. 13, at 3 o'clock, p.m. The topics for discussion are: "Nicaragua Canal," "World's Fair," and "Bureau of Information." A paper entitled "The Effect of Cylinder Clearance Upon Steam Economy" will be presented by Mr. Ira C. Hubbell, President and Treasurer, Locomotive Appliance Company.

PERSONAL.

(For other personal mention see Elections and Appointments.)

—Mr. W. K. Bixby has been elected Chairman of the Board of Directors of the American Car & Foundry Company, to succeed the late Mr. McMillan.

—Mr. Frank M. Wilmot, hitherto employed in the Voluntary Relief department of the Pennsylvania Railroad at Trenton, has resigned, to go to Pittsburgh as Assistant Superintendent of the Carnegie Pension & Relief Fund.

—Mr. Virgil G. Bogue has gone to New Zealand, where he will probably spend three or four months. He has gone for the purpose of preparing a report, for the government, on the various projects for building a railroad across the Middle Island.

—Mr. M. Riddle, Jr., Superintendent of the Richmond Division of the Atlantic Coast Line, is a native of Virginia, having been born in Petersburg, Aug. 10, 1869. He was connected with the Norfolk & Western for two years. From 1891 to 1901 he was roadmaster of the Atlantic Coast Line and was promoted to his new position on Nov. 1 last.

—On Dec. 6 the President appointed three delegates to represent the United States at the ninth International Engineering Congress, to be held at Dusseldorf, Germany, in June next. These delegates are: Lieut. Col. Charles W. Raymond, Corps of Engineers, U. S. A.; Major B. M. Harrod, C. E., civil member of the Mississippi River Commission, and Mr. John Bogart, C. E.

—Mr. S. C. Graham, Division Master Mechanic of the Chicago & North Western, was born at Crestline, Ohio, Dec. 19, 1862. He began his railroad career as a machinist in the Pennsylvania Railroad shops at Crestline in 1879, and was for a short time with the Toledo & Ohio Central at Bucyrus, Ohio, also in the Cincinnati, Hamilton & Dayton shops at Lima. Passing through the various grades he rose from machinist to Division Master Mechanic of the Chicago & North Western, at Mason City, Iowa. In July, 1900, he was transferred to the Sioux City Division at Lake City.

—Mr. J. G. Metcalfe, who, on Nov. 15, became General Manager of the Evansville & Terre Haute, started as a telegraph operator, later becoming train despatcher, first for the Pittsburgh, Cincinnati, Chicago & St. Louis, at Dennison, and then at Logansport, Ind. In 1872 he went with the Louisville & Nashville as chief despatcher, then became Superintendent of Transportation, and in 1881 Division Superintendent. Four years later he was made Superintendent of the St. Louis and Nashville line at Evansville. In 1886 Mr. Metcalfe was appointed General Manager of the Louisville & Nashville, which position he held until 1900, when he resigned to take a similar position with the Denver & Rio Grande.

—Mr. Edward M. Roberts, recently appointed Superintendent of Motive Power and Equipment of the Detroit Southern, was previously the Southern Agent for the Atlantic Brass Company. He was born in Wales, Oct. 16, 1849, and his railroad career dates from 1865 when he began as a fireman, later becoming engineman, on the Lexington & Big Sandy. For nine years he ran an engine on the Little Miami Division of the Pittsburgh, Cincinnati & St. Louis. In April, 1881, he was made Master Mechanic and Master Car Builder of the Ashland Coal & Iron Railway, where he remained until 1885, when he became Superintendent of Motive Power and Superintendent of Railway Department, including transportation and maintenance of way. From 1890 to 1891 Mr. Roberts was Master Mechanic of the Georgia Division of the East Tennessee, Virginia & Georgia, and in the last-named year went with the the South Carolina Railway as Superintendent of Motive Power. He left this company to go with the Washington Carbon Works as Superintendent, but in 1897 re-entered railroad service as Assistant Superintendent and Master Mechanic for the South Atlantic & Ohio. For eight months he was Superintendent of the Sterlingworth Railway Supply Company, from which position he went to the Atlantic Brass Company.

ELECTIONS AND APPOINTMENTS.

Baltimore & Ohio Southwestern.—The office of Engineer Maintenance of Way has been abolished. The jurisdiction of J. M. Graham, Chief Engineer of the Baltimore & Ohio, with headquarters at Baltimore, Md., has been extended over the Southwestern Division, effective Dec. 1.

Charleston & Western Carolina.—G. S. LeGrande has been appointed Acting General Auditor, with headquarters at Wilmington, N. C., succeeding W. A. Riach, General Auditor.

Chicago Great Western.—O. Cornelisen has been appointed Superintendent of the Fort Dodge Division, with headquarters at Fort Dodge, succeeding O. B. Grant resigned. C. E. Dafoe becomes Superintendent of the W. M. & P. Division, consisting of the Canon Valley; Duluth, Red Wing & Southern and Winona & Western lines, with headquarters at Red Wing.

Chicago, Rock Island & Pacific.—Newspaper reports are very general in the statement that W. G. Purdy, President, is to resign and that Mr. W. B. Leeds is to succeed Mr. Purdy.

Dansville & Mount Morris.—E. T. Wood has been appointed Auditor, succeeding Howard L. Wood, Acting Auditor, resigned, effective Dec. 31.

Grand Trunk.—We are informed that the persistent reports that G. C. Jones, Superintendent of the Middle Division, has resigned are incorrect.

Great Northern of Canada.—James McNaught has been elected First Vice-President. H. H. Melville succeeds Mr. McNaught as Second Vice-President, and Mr. Melville in turn is succeeded by V. Chateauvert, as Third Vice-President.

Illinois Central.—J. M. Dickinson, heretofore General Solicitor, has been appointed General Counsel, succeeding B. F. Ayer, resigned.

Kingston & Central Mississippi.—The following appointments have been made: J. D. Whitmore, General Freight and Passenger Agent; F. L. Curtis, Superintendent, and H. Lampe, Purchasing Agent. Headquarters at Laurel, Miss.

Lake Erie & Detroit River.—T. Marshall, heretofore Assistant General Freight and Passenger Agent, has been appointed General Freight and Passenger Agent. Owen McKay, heretofore Engineer, becomes Chief Engineer, both with headquarters at Walkerville, Ont.

Lehigh & Hudson River.—L. A. Reiley, heretofore Vice-President, has been elected President.

Mexican Central.—W. T. Provence, heretofore Trainmaster, has been appointed Division Superintendent, with headquarters at Chihuahua, Mex., succeeding D. F. Bucher, resigned. (See Monterey & Mexican Gulf.)

Monterey & Mexican Gulf.—D. F. Bucher, heretofore Division Superintendent of the Mexican Central, has been appointed Superintendent of the M. & M. G., with headquarters at Monterey, Mex.

Newburg & South Shore.—A. F. Allen has been elected Secretary and J. H. Early Assistant Secretary. C. A. Vogt has been appointed General Auditor, with headquarters at Cleveland, Ohio, succeeding C. A. Honecker. A. H. Garry, Auditor, has resigned.

Ohio & Kentucky.—R. M. Broas, General Manager, has resigned.

Omaha, Kansas City & Eastern.—The headquarters of W. J. Stoneburner, Superintendent, has been removed from Stanberry, Mo., to Kansas City; also the headquarters of A. W. Quackenbush, Master Mechanic, has been removed from Stanberry to Milan.

Philadelphia & Reading.—J. E. Turk has been appointed Superintendent of the Wilmington & Columbia Division, succeeding A. G. McCausland, resigned, effective Dec. 5. Mr. McCausland continues as Superintendent of the Atlantic City R. R.

Queen & Crescent.—A. A. Woods, Jr., has been appointed Acting Resident Engineer of the Alabama & Vicksburg, succeeding L. W. Stubbs, Resident Engineer.

Rutland.—George Cassidy, heretofore General Freight Agent, has been appointed Freight Traffic Manager. F. Owen becomes Assistant Freight Traffic Manager, and Mr. Cassidy is succeeded by F. T. Goodman. H. A. Hodge, heretofore Traffic Manager, has resigned.

St. Louis & San Francisco.—J. S. Ford has been appointed Assistant Secretary and Assistant Treasurer, succeeding Frederick Strauss.

Seaboard Air Line.—R. P. C. Sanderson, heretofore General Purchasing Agent, has been appointed Superintendent of Motive Power, succeeding F. H. McGee, transferred, effective Dec. 9.

Southern.—M. A. Zook, Engineer Maintenance of Way of the St. Louis-Louisville Lines, has resigned. B. C. Milner, heretofore Resident Engineer, succeeds Mr. Zook at Louisville, Ky.

Tallulah Falls.—W. S. Erwin has been appointed General Manager, succeeding S. C. Dunlap, resigned.

Virginia & Southwestern.—G. P. Johnson has been appointed Superintendent, succeeding C. A. Shields.

RAILROAD CONSTRUCTION.

New Incorporations, Surveys, Etc.

ATLANTIC, VALDOSTA & WESTERN.—An officer sends the following information about the proposed extension from Valdosta to the Chattahoochee River. The route is to be by way of Morven and Moultrie, northwest to Albany, Ga., 75 miles. Two preliminary surveys of the

route have already been made, and it is proposed to let contracts for grading, track laying, etc., in about two months. There is some heavy work to be encountered, with maximum curves of 4 deg. A 1,200-ft. span bridge over the Flint River will be required.

Baltimore & Ohio.—Surveys are reported in West Virginia from a point near Martinsburg to limestone deposits in Berkeley County.

Blue Grass Consolidated Traction.—This company was incorporated in Kentucky, Dec. 3, with an authorized capital stock of $7,000,000, to build trolley lines connecting Lexington with Paris, Winchester, Mt. Sterling, Richmond, Versailles, Frankfort, Nicholasville and Georgetown, Ky., a total of about 140 miles of railroad. The general power house is to be in Lexington. The incorporators are: H. C. Beatty, George B. Davis, H. B. Davis, Detroit; C. B. Knapp, Jr., Chicago; W. J. Loughbridge, Hal. P. Headley and M. C. Alford, of Lexington.

California Eastern.—Contract has been let to Bright & Crandall for laying eight miles of track of the projected extension beyond Manvel, the work to be done at the rate of $500 a mile. Grading is now practically completed and track laying is to be commenced at once. (Nov. 15, p. 797.)

California Roads.—Work is reported on a short railroad in Santiago County, to run from the mines of the California King Salt Mining Co. to the Colorado River at Picacho.

Surveys are reported for a new line between Marysville and Grass Valley, a distance of about 36 miles. Ayer Bros., of Grass Valley, are said to be interested.

Cape Girardeau & Northern.—This company has been formed in Missouri to build between Cape Girardeau and Crystal City, 95 miles. Surveys are in progress and it is thought that contracts will be let very soon. Newman Erb is President.

Cedar Rapids, Iowa City & Southern (Electric).—The organization of this company was completed in Iowa, Dec. 4, with capital stock of $100,000, and headquarters at Cedar Rapids, to build an electric line from Cedar Rapids to Iowa City, 33 miles. It is the intention to extend the line south from Iowa City toward Burlington. The officers are: President, William G. Dows; Vice-President, William J. Greene; Secretary and Treasurer, Isaac B. Smith, all of Cedar Rapids. The abovenamed officers also constitute the board of directors.

Chesapeake Transit.—Work was begun, Nov. 27, on the new line between Norfolk, Va., and Cape Henry, a distance of about 16 miles. Porter & Butt, of Portsmouth, Va., are the contractors, and, according to the terms of the contract, the road must be completed by June 1, 1902.

Comer & Lavonia.—Surveys are reported for a new railroad from Comer, Ga., on the Seaboard Air Line, to Lavonia, Ga., on the Southern, by way of Danielsville, Fort Lamar and Carnesville, a total distance of about 43 miles in a northerly direction through Franklin and Madison counties. Right of way is being secured and the prospects of building are said to be good. Hon. James M. Smith, of Oglethorpe, Ga., is interested.

Cumming & Buford Electric.—This company was incorporated, Nov. 19, with a capital stock of $500,000, to build an electric line from Buford, in Gwinnett County, Ga., to Cumming, in Forsyth County, a distance of 11 miles northwest, crossing the Chattahoochee River at or near the Garner bridge. The incorporators are: J. B. Puett, and R. W. Shadburn, of Forsyth County, Ga.; H. D. Jaquish, Hall County, Ga.; J. O. Brown, Gwinnett County, Ga., and others.

Dallas & New Mexico.—It is announced that this company has secured 60 miles of graded line between Letot and Boyd, Texas, and also a franchise to build in Dallas. The proposed road is to be 75 miles long and will be completed as soon as possible.

Dalton & Alaculsy.—Surveys are reported for an extension of this line to Murphy, N. C., and contract has been let for part of the line in Georgia and a portion is reported completed. The road was originally incorporated last April, with a capital stock of $300,000, to build a road 56 miles long between Dalton, in Whitfield County, northeast to Blue Ridge in Fannin County. M. S. Squires, of Binghamton, N. Y., is President. (Construction Supplement, Oct. 11, 1901.)

Des Moines & Southwestern.—Surveys are reported completed in Madison and Adair counties, Iowa, for a railroad projected between Des Moines and Creston, 56 miles southwest, air line. The project is thought to be a continuation of the proposed line of the Des Moines, Iowa Falls & Northern. Surveys are in charge of B. Schreiner.

Fairmount & Clarksburg Electric.—Twelve miles of this West Virginia line is reported completed out of the total of 34 projected. H. Schmulback is President.

Fitzgerald, Ocmulgee & Red Bluff.—This company was incorporated in Georgia, Nov. 9, with a capital stock of $200,000, to build a steam railroad from Fitzgerald in a northeasterly direction, crossing the Seaboard Air Line at or near Queenland, Wilcox County, thence across the Ocmulgee River to Helma or McRae, in Telfair County, and from there to Red Bluff, Montgomery County, a total of about 50 miles. The incorporators are: T. W. Garbut and R. V. Bowers, of Wilcox County, Ga.; Thomas Wilson and J. E. Mercer, of Irwin County, Pa., and others. (Nov. 22, p. 816.)

Fort Smith & Western.—This proposed line in Arkansas is reported surveyed for 55 miles, and contracts covering that distance have been let. It is thought that the road will be completed next year and additional contracts are to be let at once. J. J. Mahoney, of Fort Smith, is General Manager. The line, as originally incorporated, was to extend from Fort Smith, Ark., west through Indian Territory to Guthrie, Okla. T., 175 miles. (Construction Supplement, Oct. 11, 1901.)

Georgetown & Lexington Traction.—Twelve miles of road in Kentucky between the towns named are reported completed, and franchises are also said to have been secured between Lexington and Paris, Ky., 48 miles. Surveys are reported on this latter extension. Y. Alexander, Brooksville, Ky., is President.

Grand Trunk of Canada.—Contract was signed, Dec. 4, for a line about 12 miles long extending in a western direction from Burk's Falls, on the Canadian Northern, to the head of navigation, on the Magnetewan. This is said to mark the beginning of the Grand Trunk's proposed line to Sault Ste. Marie.

Kanawha, Glen Jean & Western.—It is reported that this new line in West Virginia, of which about three miles are now completed, will build about 15 miles of line south from Thurmond, W. Va., and that contracts will be let next spring. S. N. Veail, Chillicothe, Ohio, is Treasurer of the company.

Kanawha Valley Traction.—This company has been incorporated in West Virginia to build an electric road between Charleston and St. Albans, 18 miles, on the opposite bank of the Kanawha River. The capital stock is placed at $200,000. J. Carmick and J. E. Chilton, of Charleston, W. Va., are interested.

Laramie, Hahn's Peak & Pacific.—Contract for 70 miles of grade on this new line has been awarded to Nils Callanan. Grading is reported completed between Laramie and Little Laramie River, 19 miles, and the new contract will carry the work beyond Gold Hill, in Carbon County, Wyo. The entire grade will be completed this winter, if weather permits, and track will be laid early in the spring. (Nov. 8, p. 782.)

Long Island R. R.—Ground was broken, Dec. 3, for the extensive improvements on Atlantic avenue, Brooklyn, which are to take the line off grade. It is estimated that two years will be required for the completion of the work planned and that it will cost $3,500,000. (Nov. 8, p. 782.)

Michigan Roads.—There are at present three projects for railroads in Leelanau County covering in general the same territory between Traverse City and Northport. Two of these companies, one known as the Traverse City & Leelanau, incorporated in February, 1900, and the other promoted by Daniel Kaufman, of Marquette, have done nothing since their organization so far as can be ascertained. The third, known as the Manistee & Northeastern, has had maps approved showing an extension of its line from Solon north in Leelanau County, and it is understood that the extension will be built as far north as Northport, although the complete map of the line has not yet been filed. (Oct. 25, p. 746; Sept. 27, p. 676.)

Missouri Pacific.—It is stated that rails are being received for the Sedalia, Warsaw & Southwestern, which is being broadened to standard gage. This subsidiary line runs between Sedalia and Warsaw, Mo., 42 miles.

Missouri Terminal.—A bill has been introduced in the St. Louis City Council to grant franchise for a belt line around the northern and western city limits, including construction of levee terminals. The object of the bill is chiefly to prepare the way for building the proposed third bridge between St. Louis and East St. Louis, at an estimated cost for bridge and terminals of at least $7,500,000. The officers of the company are Mayor M. M. Stephens, of East St. Louis, President; A. J. Tullock, Leavenworth, Kan., Vice-President, and W. S. Forman, East St. Louis, Secretary and Treasurer.

O'Neill & Atkinson.—A movement has been started in Sioux City for the organization of a company under the above name to build from O'Neill, Neb., the present terminus of the Pacific Short Line, to Atkinson, Neb., the starting point of the Atkinson & Niobrara, 20 miles. The purpose of the line is to hold for Sioux City a trade which has been enjoyed for years, but which will be largely diverted to Omaha, if the Fremont, Elkhorn & Missouri Valley builds its proposed extension from Verdigris to Niobrara or Butte, Neb.

Oregon Roads.—A company has been organized in Union, Ore., to build a railroad along Catharine Creek from Union, in Union County, to the Cornucopia mines, a distance of about 35 miles in an easterly direction. Rights of way are being secured.

Phillipsburg & Washington Street.—This company has been incorporated in New Jersey, with a capital stock of $500,000, to extend a trolley line now in existence from Phillipsburg, in Warren County, to the cement works at Alpha, Vulcanite and Washington, a total of about 18 miles in Warren County. Incorporators are Robert E. Wright, of Allentown, Pa.; C. N. Bates, of Brooklyn, N. Y., and Wm. M. Davis, of Phillipsburg, New Jersey.

Rutland.—An officer writes in regard to the surveys reported from North Bennington, Vt., that the work has been undertaken to locate some sidings and possibly a cut-off, but that nothing definite has yet been determined. (Nov. 29, p. 832.)

St. Louis & San Francisco.—It is reported that this company will build a branch four miles long in Arkansas out of Rogers.

Texas Southern.—Work is reported in connecting three different lines owned by this company in Texas, each of which is about 16 miles long. When connected a continuous route will be formed between Winnsboro and Marshall, 76 miles. Contracts have already been let.

Toledo, Hicksville & Fort Wayne (Electric).—This company was incorporated in Ohio, Nov. 13, to build an electric line from Toledo in a southwestern direction into Indiana, passing through Lucas, Fulton, Williams and Defiance Counties. The incorporators are: Chas. B. Griffin and A. D. Detwiler, of Toledo, and others.

Victoria Terminal Ry. & Ferry.—Work is reported begun on the Island section of this project, which is to connect Victoria, B. C., with the Great Northern. Capt. Mackenzie, of Vancouver, is in charge of the work.

Washington & Columbia River.—Work is reported completed on the filling in of six large gulches with earth to make the roadbed solid. The work has required two years and cost $100,000. The Washington & Columbia River operates 177 miles of line in Oregon and Washington and is controlled by the Northern Pacific, but managed as a separate company.

Washington Terminal.—This company has filed articles of incorporation with the Recorder of Deeds at Washington, D. C., with a capital stock of $5,000,000. All of the $500,000 of stock certificates issued so far are said to be held by the Baltimore & Ohio and the purpose of the company is to provide for the building of new terminals and tracks for the Baltimore & Ohio and to eliminate grade crossings in the District of Columbia as required by an act of Congress.

Yorktown, Hampton, Jamestown & Williamsburg.—This company has secured charters of the Yorktown, Poquoson & Hampton and the Jamestown, Williamsburg & Yorktown railroads and expects to start work Jan. 1, 1902, or before. It is estimated that the main line will be about 45 miles long. (See Yorktown, Poquoson & Hampton, Construction Supplement, Oct. 11, 1901.)

GENERAL RAILROAD NEWS.

Baltimore & Ohio.—New 4 per cent. Pittsburgh, Lake Erie & West Virginia Division refunding mortgage bonds to the extent of $20,000,000, out of an issue of $75,000,000, have been purchased by Kuhn, Loeb & Co. This mortgage was made to finance the recent purchases of the Ohio River, Cleveland, Lorain & Wheeling. Pittsburgh & Western and other properties, and will provide also for the redemption of outstanding issues as they mature, and for general betterments. The subsidiary companies' securities now held in the treasury of the Baltimore & Ohio will be deposited as collateral security for the new bonds. The details of the issue are not announced, but it is thought that the bonds will be of 40 years' duration, with redemption after 1925 provided for.

Boone, Rockwell City & Northwestern.—New 5 per cent. first mortgage gold coupon bonds, due 1913, and secured by trust deed upon the company's property, are offered to the extent of $1,300,000. The company has now in operation that part of its proposed line between Boone, Iowa, and Rockwell City, Iowa, 52 miles, extending betwen Gowrie and Fraser, about 25 miles, and it is proposed by means of the present issue of bonds to refund its existing indebtedness and extend the line to the projected terminals. The company also owns 3,500 acres of coal lands and coal rights, the value of which, in connection with four mining shafts in operation, buildings and equipment, is placed at upwards of $1,000,000. This property also is included in the trust deed.

Chicago, Burlington & Quincy.—The statement for the four months ending Oct. 31, 1901, shows gross earnings of $19,627,398, as against $18,389,256 for the same period last year, an increase of $1,238,142. Operating expenses and fixed charges for the four months this year were $14,671,691, as against $14,032,443 last year, an increase of $639,248. The resulting net earnings for the four months in 1901 were $4,955,707, an increase of $598,894 over the figure for last year.

Cleveland, Elyria & Western.—A block of first consolidated 5 per cent. gold bonds, due 1920, are being offered by Cyrus Pierce & Co., of Philadelphia, at 101½. An issue of $1,500,000 was authorized and there are outstanding $1,000,000, and $500,000 in trust to retire underlying bonds. The bonds referred to above are offered to provide for the cost of a 21-mile extension between Oberlin and Norwalk, Ohio, 21 miles, which, when completed, will give a total of 90 miles of line owned by the company.

Columbus, Sandusky & Hocking.—Judgment for $2,575,825 and costs was given by the U. S. Court at Columbus, Ohio, against this company, and in default the mortgages are to be foreclosed and the property sold within 60 days. No bid for less than $2,550,000 will be received. The Columbus, Sandusky & Hocking operates a total of 269 miles, of which 218 is owned and the remainder leased for use under trackage rights. The main lines include the road from Fair Grounds to Sandusky, O., 111 miles, which is known as the Sandusky Division, and the Shawnee Division, between Columbus and Shawnee, Ohio, 86 miles. A decree of foreclosure was first entered on March 10, 1900, and this decree was affirmed with slight modifications by the Circuit Court of Appeals in opinions handed down April 2 and May 7, 1901.

Columbus, Wellston & Southern.—This property, sold recently at Columbus, Ohio, in foreclosure, was bought for $75,000 by Judge J. G. Reeves, of Lancaster, Ohio, in the interest of Boston parties. The road was projected between Columbus and Wellston, about 100 miles, and work was started on it in 1893, but only about 25 miles was built. It was designed to afford a short line from Columbus to coal fields in the southern part of the State, and it is the plan of the present purchasers to reorganize it and complete it along the line of the original surveys.

Houston & Texas Central.—An officer denies the current press reports that the Texas Central, now under lease to the above, has been absorbed by it. He states that the rumor is without foundation.

Illinois Central.—It is stated that the Kentucky Western, 19 miles long, which was opened last January between Dixon and Blackford, Ky., has been taken over by the Illinois Central as agent for its owners. It has previously been operated under a traffic contract by this company, with whose lines it connects at Blackford.

Mexican National.—Speyer & Co., of New York, Kuhn, Loeb & Co., of New York, and Speyer Bros., of London, give notice to all holders of bonds and stock of this company that the deposit of over 99½ per cent. of the outstanding second mortgage series "A" and "B" bonds, all of the income bonds, and over 97½ per cent. of the stock (trust certificates) under the plan and agreement for the re-adjustment of the Mexican National, dated Oct. 8, 1901, being assured, further deposits of bonds and stock will only be accepted upon a cash payment of 2 per cent. on the par value of the bonds, and $2 per share of the stock. After Dec. 31, 1901, no further deposits of such bonds or stock will be accepted except in each instance in the discretion of the re-adjustment managers and upon such terms as they may impose. (Oct. 18, p. 730.)

St. Louis & San Francisco.—To provide for new equipment recently ordered, a 4 per cent. car trust for $1,500,000 is to be formed.

Springfield & Xenia Traction.—This company, which is successor of the Little Miami Traction Co., has authorized a mortgage to secure a $500,000 issue of bonds, to be applied to payment for its new line in Ohio.

Texas & New Orleans.—Application has been filed with the Railroad Commission for authority to register an issue of $1,200,000 Dallas Division first mortgage 4 per cent. bonds, on 60 miles of new road, and on certain property which has been added since the last gold bonds to the amount of $1,474,000 were issued.

Tuscarawas Traction.—Incorporation has been made in the State of Ohio of a company by this name, with $350,000 stock authorized, as a consolidation of the Tuscarawas R. R., and Tuscarawas Traction companies, owning a total of about 15 miles of line between New Philadelphia and Canal Dover, Ohio, by way of Uhrichsville. It is reported that the line is to be extended to Strasburg, six miles. There are in existence $200,000 of outstanding bonds of the two companies combined.

Utica & Mohawk Valley.—N. W. Harris & Co., of New York, offer $1,400,000 40-year 4½ per cent. gold bonds with no option of prior payment. The New York Security & Trust Co. is the trustee for these bonds, which are secured by mortgage on the company's entire street railroad system, operating under perpetual franchise in Utica and adjacent cities, including branches now building along the Mohawk River Valley, a total trackage of about 96 miles. (Oct. 11, p. 712.)